Draft Highway Traffic Noise Report
I-496 Design-Build
Lansing Road to the Grand River

Prepared for

Michigan Department of Transportation
425 W. Ottawa St., 3rd Floor
P.O. Box 30050
Lansing, MI 48909
517-241-2445

Aug. 19, 2021

Prepared for:

Michigan Department of Transportation
425 W. Ottawa St., 3rd Floor
P.O. Box 30050
Lansing, MI 48909

Prepared by:

Paul Burge, INCE Board Cert
Principal Acoustics and Noise Control Engineer
T: 619-610-7873
E: paul.burge@aecom.com

Yona Simonson
Noise Control Specialist
T: 619-610-7600
E: yona.simonson@aecom.com

AECOM
401 West A St.
Suite 1200
San Diego, CA 92101
aecom.com

Table of Contents

List of Acronyms and Abbreviations 5
Executive Summary 6
1. Introduction and Project Description 7
    1.1 Project Description 7
    1.2 Description of Alternatives 7
2. Traffic Noise Concepts 9
    2.1 Glossary of Acoustical Terms 9
    2.2 Fundamentals of Traffic Noise Assessment and Control 10
    2.3 Regulatory Overview 13
    2.3.1 Federal Regulations 13
    2.3.2 State Regulations and Policies 14
3. Methods of Noise Analysis 15
    3.1 Defining Area or Potential Impact 15
    3.2 Field Measurement Procedures 15
    3.3 Analysis Objectives 16
    3.4 Selection of Noise-Sensitive Receptors 16
    3.5 Loudest Hour Noise Conditions 17
    3.6 Noise Abatement Requirements 17
    3.7 Noise Modeling Methodology 18
    3.8 Project Traffic Data 18
    3.9 Existing Condition and Common Noise Environments 19
    3.9.1 Existing Land Use and Zoning 19
    3.9.2 Common Noise Environments 19
    3.9.3 Existing Noise Environment 21
    3.9.3.1 Field Noise Measurements 21
    3.9.3.2 Noise Model Validation and Results 21
4. Noise Impact Analysis 23
    4.1 Future Noise Levels and Impacts 23
    4.1.1 Predicted Noise Levels and Noise Impacts 23
5. Noise Abatement Evaluation 24
    5.1 Noise Abatement Measures 24
    5.2 Feasible and Reasonable Criteria and Requirements 24
    5.3 Findings and Recommendations for Noise Abatement 24
    5.3.1 CNE-1 Noise Abatement Analysis 26
    5.3.2 CNE-2 Noise Abatement Analysis 26
    5.3.3 CNE-3 Noise Abatement Analysis 26
    5.3.4 CNE-4 Noise Abatement Analysis 26
    5.3.5 CNE-5 Noise Abatement Analysis 27
    5.3.6 CNE-6 Noise Abatement Analysis 27
    5.3.7 CNE-7 Noise Abatement Analysis 27
    5.3.8 CNE-8 Noise Abatement Analysis 27
    5.3.9 CNE-9 Noise Abatement Analysis 27
    5.3.10 CNE-10 Noise Abatement Analysis 27
6. Construction Noise Analysis 31
    6.1 Typical Construction Noise Levels 31
    6.2 Construction Noise Abatement Measures 32

7. Information for Local Government Officials 34
8. Conclusions and Recommendations 34
9. Statement of Likelihood 34
10. References 34
Appendix A: Noise Measurement Data and Documentation 35
Appendix B: Sample TNM Input/Output Files 56
Appendix C: Predicted Noise Levels and Impacts 58
Appendix D: Noise Barrier Analysis Detail 65

Figures

Figure 1-1 Project Overview 8
Figure 2-1 Simple Noise Barrier Geometry 12
Figure 2-2 Path Length Difference for Varying Receiver Geometry 13
Figure 3-1 Long-Term Noise Measurement Data 15
Figure 3-2 Common Noise Environments and Noise Measurement Sites 20
Figure 5-1 Acoustical Analysis for CNE-1, CNE-2, CNE-3, and CNE-4 28
Figure 5-2 Acoustical Analysis for CNE-5 and CNE-6 29
Figure 5-3 Acoustical Analysis for CNE-7, CNE-8, CNE-9, and CNE-10 30

Tables

Table ES-0-1 Summary of Project Impacts and Proposed Noise Abatement 6
Table 2-1 Common Indoor and Outdoor Noise Levels 11
Table 2-2 Relationship Between Changes in Noise Level and Perceived Loudness 11
Table 2-3 FHWA Noise Abatement Criteria 14
Table 3-1 Existing and Future Traffic Volumes 18
Table 3-2 Common Noise Environments 19
Table 3-3 TNM Validation Summary 22
Table 4-1 Summary of Predicted Noise Levels by CNE 23
Table 5-1 Noise Wall Descriptions 25
Table 5-2 Barrier Analysis Results 26
Table 6-1 Typical Construction Equipment Noise Levels 32
Table 7-1 Noise Impact distances for undeveloped lands 34

List of Acronyms and Abbreviations

ANSI	American National Standards Institute
CNE	Common Noise Environment
CPBU	Cost Per Benefited Receptor Unit
dB	Decibel (measure of sound pressure level on a logarithmic scale)
dBA	A-weighted decibel (sound pressure level)
DU	Dwelling Unit
DUE	Dwelling Unit Equivalent
FHWA	Federal Highway Administration
Leq	Equivalent sound level (energy averaged sound level)
Leq(1h)	A-weighted, energy average sound level during a 1-hour period
LOS	Level-of-Service
LT	Long-Term
MDOT	Michigan Department of Transportation
Mph	Miles per hour
NAC	Noise Abatement Criteria
NR	Noise Reduction
ROW	Right of Way
ST	Short-Term
TNM	Traffic Noise Model

Executive Summary

This noise analysis was conducted to assess the noise impacts and potential noise abatement associated with an I-496 design-build improvement project from Lansing Road to the Grand River in Lansing, Michigan. I-496 in this area experiences a high volume of traffic daily. This project is intended to ease congestion, increase safety by adding new eastbound and westbound auxiliary lanes between Lansing Road and the Martin Luther King (MLK) Jr. Boulevard ramps, and realigning through-traffic lanes closer to the center of the roadway between Lansing Road and the Grand Avenue and Walnut Street ramps.

The Federal Highway Administration (FHWA) defines Type I projects as federal highway projects in a new location, a physical alteration of an existing highway that significantly changes either horizontal or vertical alignment or increases the number of through lanes. The Michigan Department of Transportation's (MDOT) I-496 Lansing Road to Grand River project includes the addition of an auxiliary lane totaling approximately 2,800 feet and ramp realignment, thus meeting the Type 1 project criteria under Title 23: Highways - Part 772.5. FHWA requires a noise study for all Type I projects to assess potential noise impacts and mitigation options.

This noise study included on-site noise measurements in the project vicinity, conducted in October 2020. Two long-term measurements were conducted, one along each side of the highway, along with 10 short-term measurements dispersed across the project area.

A model was developed in the FHWA Traffic Noise Model (TNM) version 2.5 and validated against these field measurements. Noise sensitive receptors were then identified and classified with existing and future levels calculated in TNM 2.5. These predicted levels were checked against FHWA and MDOT noise abatement criteria standards to determine impacts in the area. Noise abatement for these impacts were analyzed according to MDOT feasibility and reasonableness standards.

The project included 10 Common Noise Environments (CNEs), with impacts identified in nine of the 10. Abatement was considered in several locations but only recommended in one. A summary of these findings is presented in Table ES-0-1 and discussed in more detail in the body of the report.

Table ES-0-1 Summary of Project Impacts and Proposed Noise Abatement

CNE	Description/Location	2020 Impact	2040 Impacts	Recommended Noise Abatement
CNE-1	Single-family homes, north of I-496, west of Grand Avenue	12	12	677-foot Noise Barrier
CNE-2	Multi-family residential, south of I-496, west of Grand Avenue	2	2	Not Recommended
CNE-3	Mixed use, commercial residential, north of I-496, between Grand Avenue and Walnut Street	0	0	No Impacts
CNE-4	Michigan Women’s Historical Center and Gardens, south of I-496, between Grand Avenue and Townsend Street	2	2	Not Recommended
CNE-5	Mixed use, commercial and residential north of I-496, between Walnut Street and Pine Street	5	5	Not Recommended
CNE-6	Mixed use, commercial and residential, north of I-496, between Pine Street and MLK Jr. Boulevard	29	29	Not Recommended
CNE-7	Single-family homes, north of I-496, between MLK Jr. Boulevard and Everett Drive	35	35	Not Recommended
CNE-8	Single-family homes, school, south of I-496, between MLK Jr. Boulevard and Everett Drive	16	16	Not Recommended
CNE-9	Single-family homes, school, north of I-496, between Everett Drive and Claire Street	9	9	Not Recommended
CNE-10	Single-family homes, school, south of I-496, between Everett Drive and Clare Street	10	10	Not Recommended

1. Introduction and Project Description

1.1 Project Description

This project includes improvements to I-496 between Lansing Road and the Grand River in Lansing, Michigan. The improvements include the addition of new eastbound and westbound auxiliary lanes between Lansing Road and the MLK Jr. Boulevard ramps, realignment of through-traffic lanes closer to the center of the roadway between Lansing Road and Grand Avenue, and realignment of the Walnut Street ramps. The project would also include pavement upgrades and some structural upgrades and repairs, as required. Some pavement upgrades may also be extended to service roads: St. Joseph Street to the north of the highway and Malcolm X Street to the south.

The general project location, project limits and areas of project improvements are shown in Figure 1-1.

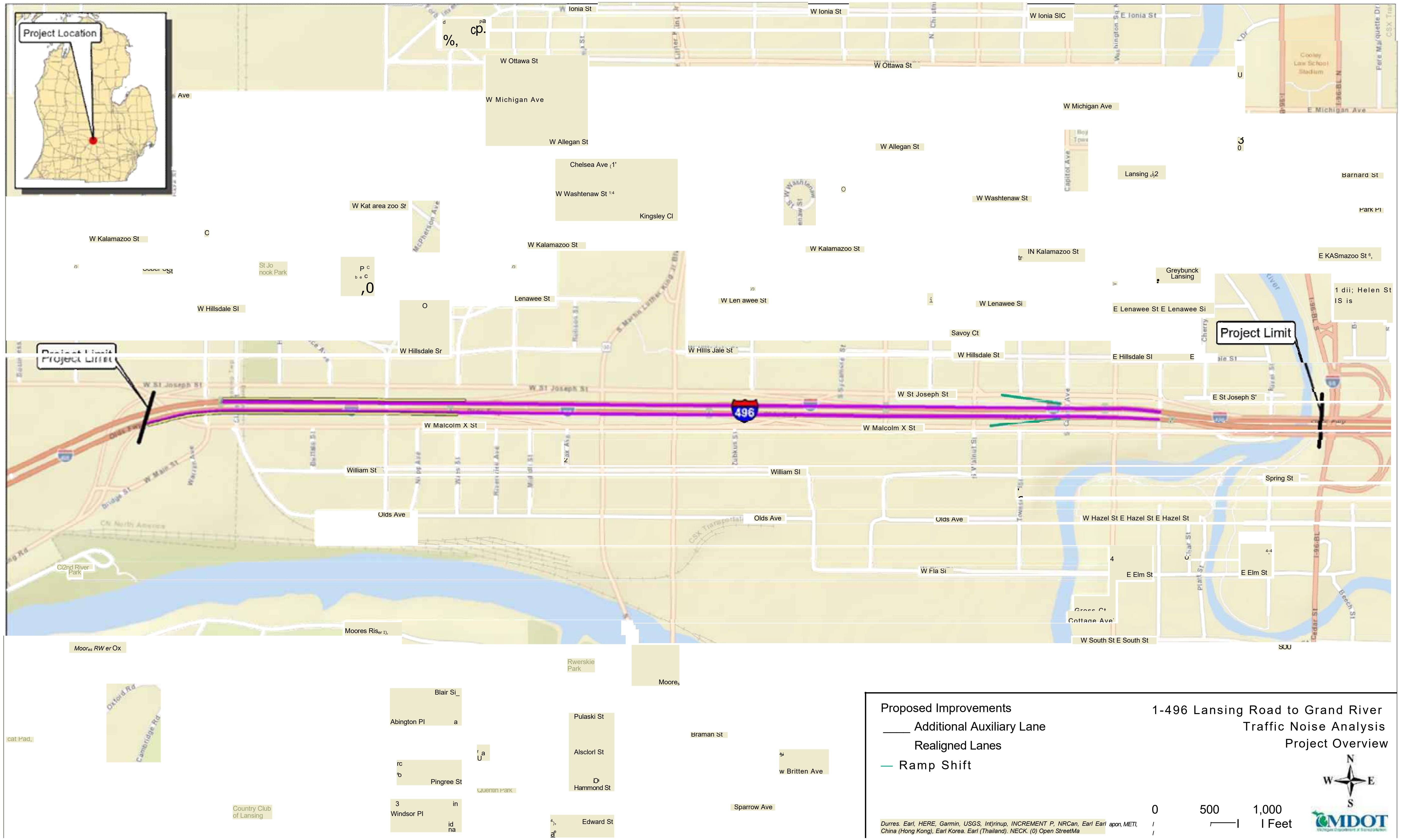
FHWA and MDOT define a Type I project as a federal highway project being built in a new location, a significant change in horizontal or vertical alignment of an existing roadway, or an increase in the number of through-traffic lanes. As this project includes addition of new mainline lanes and existing lane realignment on mainline I-496, and some ramp realignments, the entire project as defined in the environmental document meets the Type 1 project criteria and requires a noise analysis.

1.2 Description of Alternatives

This project includes one future build alternative to be evaluated:

- Future build (includes all proposed improvements and projected traffic volumes for year 2045).

Figure 1-1 Project Overview



2. Traffic Noise Concepts

This section identifies and reviews the methodology and policy for the technical tasks and analyses used in this report. The actual results of these tasks and analyses are presented in subsequent sections of this report.

2.1 Glossary of Acoustical Terms

The following glossary of acoustical terms is intended to help frame discussion of project-generated noises and their potential effects on neighboring communities in the project area.

Sound: For this analysis, sound is a physical phenomenon generated by vibrations that result in waves that travel through a medium, such as air, and result in auditory perception by the human brain.

Noise: Whether something is perceived as a noise event is influenced by the type of sound, the perceived importance of the sound, and its appropriateness in the setting, the time of day, and the type of activity during which the noise occurs, and the sensitivity of the listener. Local jurisdictions may have legal definitions of what constitutes "noise" and such environmental parameters to consider.

Frequency: Sound frequency, or "pitch," is measured in hertz (Hz), which is a measure of how many times each second the crest of a sound pressure wave passes a fixed point. For example, when a drummer beats a drum, the skin of the drum vibrates a number of times per second. When the drum skin vibrates 100 times per second, it generates a sound pressure wave that is oscillating at 100 Hz, and this pressure oscillation is perceived by the brain as a tonal pitch of 100 Hz. Sound frequencies between 20 and 20,000 Hz are within the range of sensitivity of the best human ear.

Amplitude or Level: Sound levels are measured in decibels (dB) using a logarithmic scale. A sound level of zero dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB. Sound levels above approximately 110 dB begin to be felt inside the human ear as discomfort and eventually as pain at 120 dB and higher levels. The minimum change in the sound level of individual events that the average human ear can detect is about 1 to 2 dB. A 3 to 5 dB change is readily perceived. A change in sound level of about 10 dB usually is perceived by the average person as a doubling (or if decreasing by 10 dB, halving) of the sound's loudness. Table 2-1 shows typical indoor and outdoor sounds and their corresponding dB levels, arranged on what often is referenced as an "acoustic thermometer" to show relative loudness.

Sound pressure: Sound level usually is expressed by reference to a known standard. This report refers to sound pressure level, which is expressed on a logarithmic scale with respect to a reference value of 20 micropascals. Sound pressure level depends not only on the power of the source, but also on the distance from the source and the acoustical characteristics of the space surrounding the source.

A-weighting: Sound from a tuning fork contains a single frequency (a pure tone), but most sounds heard in the environment do not consist of a single frequency; instead, they are composed of a broad band of frequencies, differing in sound levels. The method commonly used to quantify environmental sounds consists of evaluating all frequencies of a sound according to a weighting system that reflects the typical frequency-dependent sensitivity of average healthy human hearing. This is called "A-weighting," and the measured decibel level is referred to as A-weighted decibels (dBA).

Equivalent sound level: Environmental noise levels vary continuously and include a mixture of noise from near and distant sources. A single descriptor, energy-average sound level during a measured time interval (L_{eq}), may be used to describe such sound that is changing in level from one moment to another. L_{eq} is the energy-average sound level during a measured time interval. This is the "equivalent" constant sound level that would have to be produced by a single, steady source to equal the acoustic energy contained in the fluctuating sound level measured.

Day-night level (L_{dn}): The L_{dn} is the energy average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to A-weighted sound levels occurring between 10 p.m. and 7 a.m. (nighttime).

Sound transmission loss (TL): The TL is a value representing 10 times the base-10 logarithm of the ratio of sound power incident on one side of a partition to the sound power transmitted through and subsequently emitting from the other side of the partition into an adjoining space (separated from the sound in the "source" space by the partition).

Insertion loss (IL): The IL is the reduction in noise level at a location from noise abatement means, placed in the sound path between that location and a sound source.

2.2 Fundamentals of Traffic Noise Assessment and Control

Sound Propagation
Atmospheric conditions (e.g., wind, temperature gradients, humidity) can change how sound propagates over distance and can affect the level of sound received at a given location. The degree to which the ground surface absorbs acoustical energy also affects sound propagation. Sound traveling over an acoustically absorptive surface (e.g., grass) attenuates at a greater rate than sound traveling over a hard surface (e.g., pavement, expanses of open water). When located near either the sound source or the listener position, physical barriers (e.g., naturally occurring ridgelines or buildings and other topography that block the line of sight between a source and receiver) also increase the attenuation of sound over distance.

Multiple Sound Sources
Because sound pressure levels in decibels are based on a logarithmic scale, they cannot be added or subtracted in an arithmetic fashion. Therefore, sound pressure level dB are logarithmically added on an energy summation basis. In other words, adding a new noise source to an existing noise source, both producing noise at the same level, does not double the noise level. Instead, if the difference between two noise sources is 10 dBA or more, the louder noise source dominates, and the resultant noise level is equal to the noise level of the louder source. In general, if the difference between two noise sources is 0 to 1 dBA, the resultant noise level is 3 dBA higher than the louder noise source, or both sources if they are equal. If the difference between two noise sources is 2 to 3 dBA, the resultant noise level is 2 dBA above the louder noise source. If the difference between two noise sources is 4 to 10 dBA, the resultant noise level is 1 dBA higher than the louder noise source.

How Noise is Measured
Sound can vary over an extremely large range of amplitudes. The decibel (dB) is a logarithmic unit that is the accepted standard unit for measuring the amplitude of sound because it accounts for these large variations in amplitude and reflects the way people perceive changes in sound amplitude. Different sounds may have different frequency content. Frequency content of a sound refers to its tonal quality or pitch. When describing sound and its effect on a human population, A-weighted (dBA) sound levels are typically used to account for the response of the human ear. The term "A-weighted" refers to a filtering of the noise signal to emphasize frequencies in the middle of the audible spectrum and to de-emphasize low and high frequencies in a manner corresponding to the way the human ear perceives sound. This filtering network has been established by the American National Standards Institute (ANSI). The A-weighted noise level has been found to correlate well with peoples' judgments of the noisiness of different sounds and has been used for many years as a measure of community noise. Table 2-1 illustrates sound pressure levels in dBA of various sound sources between 0 dBA (threshold of hearing) and 120 dBA (threshold of pain). An increase of 3 dBA in noise level can barely be perceived, while an increase of 5 dBA is readily noticeable and considered a significant noise increase. A 10 dBA increase corresponds to a subjective doubling of loudness. A relationship between changes in noise level and loudness is indicated in Table 2-2. Since noise fluctuates from moment to moment, it is common practice to condense the noise level over a specified period of time into a single number called the Equivalent Noise Level (Leq). Many surveys have shown that the Leq properly predicts annoyance, and thus this metric is commonly used for noise measurements, prediction, and impact assessment.

Table 2-1 Common Indoor and Outdoor Noise Levels

Common Outdoor Noise Levels Noise Level	Noise Level (A-weighted decibels)	Common Indoor Noise Levels
	110	Rock Band
Jet Flyover at 1,000 feet	100	Inside Subway Train (NY)
Gas Lawn Mower at 3 feet		
Diesel Truck at 50 feet	90	Food Blender at 3 feet
Noisy Urban Daytime	80	Garbage Disposal at 3 feet
Gas Lawn Mower at 100 feet	70	Vacuum Cleaner at 10 feet
Commercial Area		Normal Speech at 3 feet
	60	
		Large Business Office
Quiet Urban Daytime	50	Dishwasher Next Room
Quiet Urban Nighttime	40	Small Theater
Quiet Suburban Nighttime		Library
	30	
Quiet Rural Nighttime		Bedroom at Night
	20	
		Broadcast and Recording Studio
	10	
	0	Threshold of Hearing

Source: Adapted from Guide on Evaluation and Attenuation of Traffic Noise, AASHTO-1974

Table 2-2 Relationship Between Changes in Noise Level and Perceived Loudness

Increase (or Decrease) in Noise Level	Loudness Multiplied (or Divided) by
3 decibels	1.2
6 decibels	1.5
10 decibels	2
20 decibels	4

How Highway Noise is Generated

Highway noise is generated from three primary sources: tire/pavement noise, engine noise, and exhaust noise. Tire/pavement noise is the noise generated by the rubber tires rolling over the pavement surface and may vary in intensity and character depending on the type and condition of both the tires and the pavement. For automobiles and light trucks traveling at typical highway speeds (faster than about 50 mile/hour), tire/pavement noise is generally the dominant noise source. For medium and heavy trucks (like large commercial delivery vehicles and long-haul tractor-trailers), engine and exhaust noise also contribute to the noise that they produce. At typical highway speeds, one large truck can produce as much noise energy as 10 automobiles. How highway noise is experienced at nearby homes is controlled by a number of factors, including the total number of vehicles on the highway, the percentage of large trucks, the average speed of the vehicles, the distance to the highway, obstructions blocking the view of the highway, and meteorological conditions. Generally speaking, the more vehicles, the higher percentage of large trucks or the closer one is to the highway, the greater the noise will be. Intervening obstructions, either manmade (buildings, walls, berms) or natural (such as intervening terrain) will reduce noise levels. Foliage and vegetation can reduce noise levels, but it must be dense (completely obscuring the view of the highway) and thick (on the order of 50 to 100 feet) in order to make a noticeable difference.

How Highway Noise Can Be Reduced

Highway noise can be reduced in several ways. Here are some of the most recognized:

Traffic Controls
The faster vehicles travel, and the higher percentage of large trucks, the louder the noise. Reduced speed limits, or more rigorously enforced existing speed limits, and heavy truck restrictions will reduce noise levels. However, the implementation of such measures is often politically difficult for the sake of lower noise levels alone.

Land Use Controls:
Perhaps the most common sense and fiscally responsible solution to highway noise, and one favored by most highway agencies, is to restrict the development of lands near highways. Restricting development of land near new highway corridors to non-noise-sensitive land uses, such as commercial or industrial activities, can eliminate most noise problems. However, this approach is not suitable for circumstances when land near existing or future highways has already been developed for residential land use.

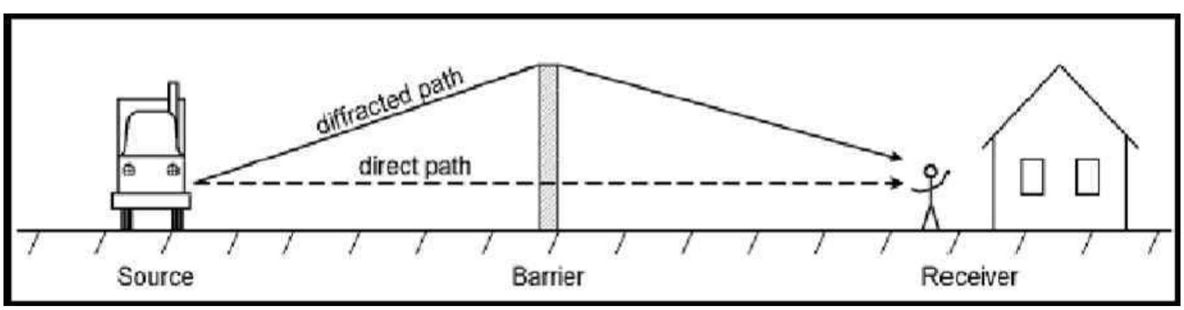
Quieter Vehicle Noise Sources
Quieter vehicles mean less highway noise. For automobiles this means quieter tires (since tire/pavement noise is the dominant noise source). For large trucks, the Environmental Protection Agency (EPA) has established standards for maximum noise levels for new and in-use trucks. The maximum noise levels for new trucks are lower than those for existing trucks, so as old trucks are phased out and replaced with newer ones, the noise produced by the average truck may go down.

Noise Barrier Walls and Berms
Noise barriers, both structural walls and earthen berms, are often built specifically for the purpose of reducing highway noise levels. Noise barriers can be very effective for reducing noise levels at nearby homes, often reducing noise levels by as much as 10 decibels at the closest homes (a perceived halving of loudness). Noise barriers can be expensive to build, on the order of $2 million per mile. Because of their cost, the building of noise barriers is often restricted to large highway improvement or construction projects. Some jurisdictions, however, are quite active in building "retrofit" noise barrier on existing highways.

Quieter Pavements
It has long been recognized that some pavement types tend to be quieter than others. White concrete pavement, for example, is typically louder than asphalt blacktop. White concrete with tining (grooves cut into the pavement surface) is louder still. However, white concrete pavement (also known as portland concrete cement, or PCC) is thought to be more durable, and perhaps safer than blacktop pavements (due to better skid resistance and drainage). There is also considerable concern that the low noise advantages of some blacktop pavements may diminish over time. As the tiny "nooks and crannies" in the blacktop pavement that give it acoustical absorption may fill up with silt and sand or become compressed over time, the acoustical benefits are reduced. The quest for quiet, safe and durable highway pavements is currently the focus of a considerable amount of research.

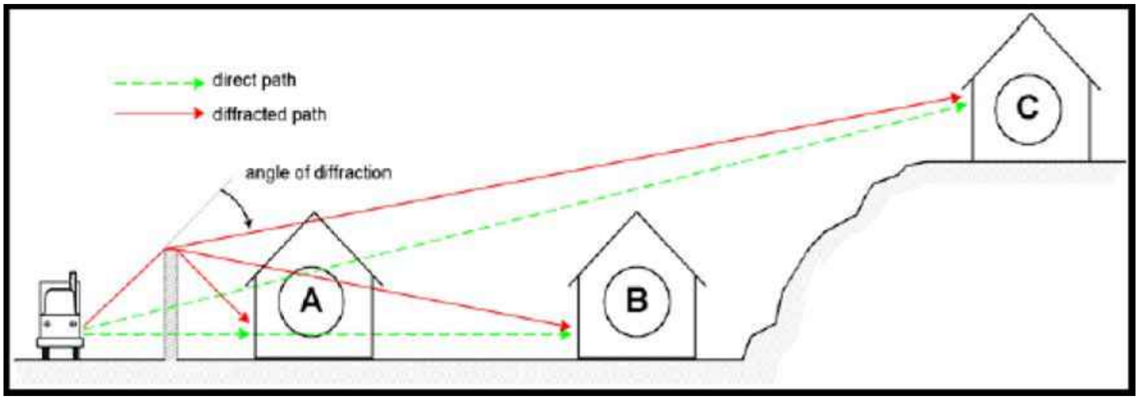
How Noise Barriers Work
Noise barriers reduce noise levels by interrupting or lengthening the path that the noise takes between the source and the receiver. In order to be effective at reducing noise, noise barriers must be able to block the "line of sight" between the object producing the noise (like vehicles on the highway) and the person subjected to the noise (like residents living near the highway). The amount that the noise will be reduced is related to the path length difference between the "direct path" that the uninterrupted sound would take between the source and receiver (with no barrier) and the "diffracted path" that the sound must take going over or around the barrier, as illustrated in Figure 2-1.

Figure 2-1 Simple Noise Barrier Geometry



Noise barriers may work better for some homes than for others. In Figure 2-2 below, home "A" is relatively close to the highway where the noise barrier can provide a large path length difference between the direct and diffracted paths, resulting in a substantial noise reduction (perhaps as much as 10 to 15 decibels). Home "B" is further from the barrier and the path length difference is not as great, resulting in less noise reduction (perhaps 7 to 10 decibels). Home "C" is even further from the highway, and also elevated above the highway level, providing an even smaller path length difference (resulting in a noise reduction of perhaps 3 to 5 decibels). In general, for a given barrier height and location, the further the receiver is from the barrier or the higher the receiver is elevated, the smaller the path length difference (or angle of diffraction) and the smaller the resulting noise reduction.

Figure 2-2 Path Length Difference for Varying Receiver Geometry



2.3 Regulatory Overview

2.3.1 Federal Regulations

The FHWA noise policy is contained within the Code of Federal Regulations, Title 23, Part 772 (23 CFR 772), which provides procedures for preparing operational and construction noise studies and evaluating noise abatement considered for federal and federal-aid highway projects. The code was recently updated in July 2010. Under the current version of 23 CFR 772.5, projects are categorized as Type I, Type II or Type III projects. The FHWA defines a Type I project as a proposed federal or federal-aid highway project for the building of a highway on a new location, or the physical alteration of an existing highway that significantly changes either the horizontal or vertical alignment, or increases the number of through-traffic lanes. The proposed project along I-496 from Lansing Road to the Grand River is a Type I project as defined by the FHWA.

Type I projects include those that create a completely new noise source, as well as those that increase the volume or move the traffic closer to a receptor. Type I projects include the addition of an interchange, ramp, auxiliary lane, or truck-climbing lane to an existing highway, or the widening of an existing ramp by a full lane width for its entire length. Projects unrelated to increased noise levels, such as lighting, signs, and landscaping, are not normally considered Type I projects.

Under 23 CFR 772.13, noise abatement must be considered for Type I projects if the project is predicted to result in a traffic noise impact. In such cases, 23 CFR 772 requires that the project sponsor “consider” noise abatement before adoption of the final NEPA document. This process involves identification of noise abatement measures that are reasonable, feasible, and likely to be incorporated into the project, and of noise impacts for which no apparent solution is available.

Traffic noise impacts, as defined in 23 CFR 772.5, occur when the design year condition noise levels approach or exceed the noise abatement criteria (NAC) specified in 23 CFR 772, or design year condition noise levels create a substantial noise increase over existing noise levels. 23 CFR 772 does not specifically define the terms “substantial increase” or “approach;” these criteria are defined in the MDOT Noise Analysis and Abatement Handbook (July 13, 2011), as described in the following section.

Table 2-3 summarizes the FHWA NAC corresponding to various defined land use activity categories. Activity categories and related traffic noise impacts are determined based on the actual land use in a given area.

In identifying noise impacts, primary consideration is given to exterior areas of frequent human use. Interior noise impacts will only be addressed for land uses listed with Activity Category D.

Table 2-3 FHWA Noise Abatement Criteria

Activity Category	Activity Criteria		Evaluation Location	Activity description
	Leq(h)	L10(h)		
A	57	60	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67	70	Exterior	Residential
C	67	70	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	55	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio stations, recording studios, schools, and television studios.
E	72	75	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	--	--	--	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	--	--	--	Undeveloped lands that are not permitted.

1 Either Leq(h) or L10(h) (but not both) may be used on a project.

2 The Leq(h) and L10(h) Activity Criteria values are for impact determination only, and are not design standards for noise.

3 Includes undeveloped lands permitted for this activity.

2.3.2 State Regulations and Policies

MDOT has published the noise policy that provides guidelines in the analysis of highway traffic noise and the evaluation of noise mitigation measures. Effective July 13, 2011, the MDOT Highway Noise Analysis and Abatement Handbook (hereafter referred to as “the MDOT handbook”) also includes current policies, procedures, and practices to be used by agencies that sponsor new building or rebuilding of federal or federal-aid highway projects. The MDOT noise handbook defines that a noise impact occurs when the sound level approaches or exceeds the assigned NAC level for a specific category, which is defined as an Leq(h) sound level 1 dBA less than the NAC identified in 23 CFR 772. This means that for an Activity Category B land use (residential), a peak hour noise level of 66 dBA is considered to approach the NAC of 67 dBA and is identified as an impact. The MDOT noise handbook defines a noise increase as substantial when the predicted traffic noise levels with project implementation exceed existing noise levels by 10 dBA. The MDOT noise handbook provides detailed technical guidance for the evaluation of highway traffic noise. This includes field measurement methods, noise modeling methods, and report preparation guidelines. In addition to the NAC criteria above, the MDOT noise handbook also specifies the following definitions and policies:

Benefited Receptor is the recipient of an abatement measure that receives a noise reduction at or above the minimum threshold of 5 dBA.

Feasible Noise Abatement Measure is a mitigation measure that is acoustically feasible and meets engineering requirements for constructability. A noise abatement measure is considered feasible when it can provide at least a 5 dBA reduction to at least 75 percent of impacted noise receptors and meets constructability, safety, access, utility, and drainage requirements.

Reasonable Noise Abatement Measure is an abatement measure that has been determined to be cost effective if it costs at or below the allowable cost per benefited receptor unit (CPBU) of $49,301 for Fiscal Year (FY) 2021, and is considered acceptable to the majority of residents and property owners who benefit from the noise abatement. The MDOT design year attenuation requirement requires that a minimum of one benefited receptor achieve a 10 dBA noise reduction and that 50 percent of benefited receptors must achieve a 7dBA reduction.

3. Methods of Noise Analysis

3.1 Defining Area or Potential Impact

The extent of the noise study analysis area should include all receptors potentially impacted by the project. The FHWA does not establish a fixed distance to define the noise impact analysis area. Historically, absolute noise impacts (those areas with noise levels approaching or exceeding the NAC – 66 dBA for residential land uses) rarely exist beyond about 500 feet from the roadway. The MDOT noise handbook defines the study zone to be a minimum of 500 feet, including all noise-sensitive receptors on all sides of the highway. If an impact is identified at 500 feet, the next closest receptor would need to be analyzed until a distance where impacts are no longer identified is reached. If no receptors are located within the 500-foot zone, then the closest receptor(s) should be analyzed.

3.2 Field Measurement Procedures

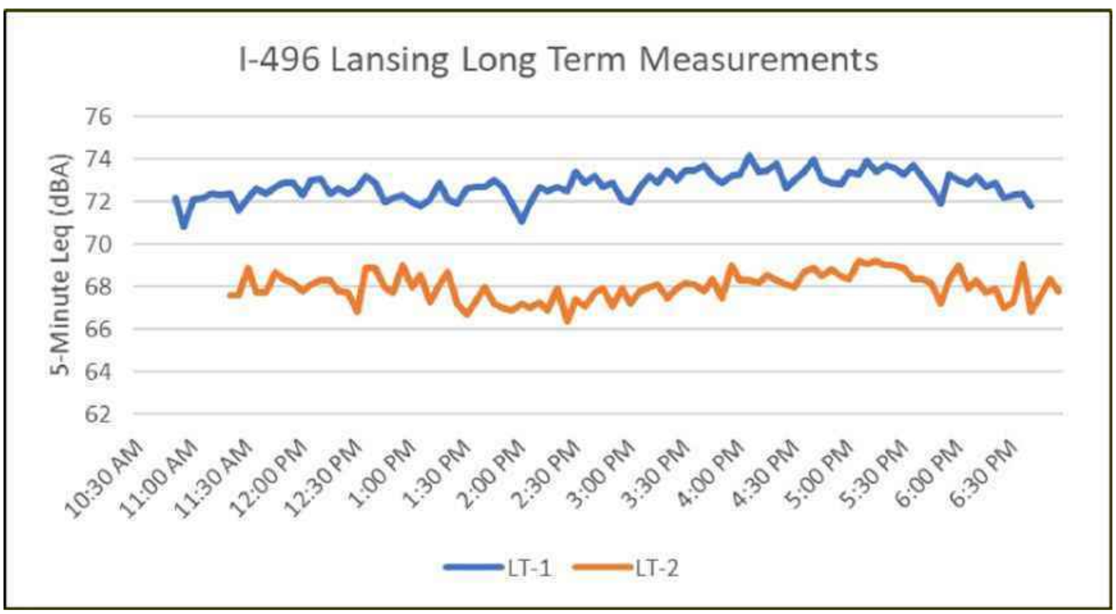
A number of field noise measurements were conducted for this project. In general, the noise measurement procedures in the field follow recommended standard procedures, including those outlined in the FHWA's Measurement of Highway Related Noise, May 1996, and the MDOT noise handbook. Specifically, the following practices and procedures were used.

The short-term noise measurements (typically 15-25 minutes) were conducted at actual or representative receptor locations and were used primarily to validate noise models (at locations where traffic noise was dominant).

Short-term noise measurements were generally conducted at exterior areas of frequent human use and were only conducted during periods of free-flowing traffic, dry roadways, and low to moderate wind speeds (less than 12 mph to avoid extraneous wind noise).

Two long-term measurements were conducted with a five-minute interval, one at each end of the project site. Initial plans called for 24-hour measurements to be conducted, but overnight rainstorms made this infeasible. Long-term measurements were approximately eight hours in length between approximately 11 a.m. and 7 p.m. The five-minute levels for LT-1 and LT-2 are shown in Figure 3-1.

Figure 3-1 Long-Term Noise Measurement Data



Only American National Standards Institute (ANSI) Class I sound level meters were used for both short-term and long-term measurements. The meters were subjected to a field calibration check before and after each measurement period. Calibration certificates for each meter used in the project can be found in Appendix A.

Concurrent traffic counts (classified in auto, medium and heavy trucks, buses, and motorcycles) for the acoustically dominant road were conducted for each short-term measurement. Traffic was videotaped during the measurements and counted. The traffic counts can be found in Table 3-3.

All field data was recorded on field data sheets, which included the time, name and location of the measurement, instrumentation data, observed meteorological data, field calibration data, a measurement site diagram, GPS coordinates, and notes as to the dominant noise sources and any other observed acoustically relevant events (such as aircraft over-flights, emergency vehicle pass-bys, etc.). Field sheets and photographs of measurement sites developed in this project can be found in Appendix A.

3.3 Analysis Objectives

The purpose of this noise analysis report is to identify and document potential noise impacts associated with the proposed future project and to identify feasible and reasonable abatement. The general analysis procedure for the project noise study includes the following steps:

1. **Review Project Description:** Review the project description and project data to be analyzed and collect additional required data (including roadway design files, existing and future traffic data, land use data, etc.). Consider all alternatives, design options, and construction phasing scenarios. This information is presented in Section 1 of this report.

2. **Identify Regulatory Framework:** Investigate and establish the regulatory framework to be followed for the noise analysis, including federal, state and local regulations and ordinances applicable to the project. This information is presented in Section 2 of this report.

3. **Noise Analysis Methodology and Establish Existing Land Use and Noise Environment:** Investigate and document the existing noise environment for the project area, including existing noise-sensitive land uses and existing noise levels in the project area. These were accomplished with a careful review of local zoning information, review of aerial photography and a site visit to the project area. This information is presented in Section 3 of this report.

4. **Predict Future Noise Levels and Assess Noise Impacts:** Future noise levels at noise-sensitive land uses for the future build alternative are predicted using the FHWA Traffic Noise Model (TNM) Version 2.5. For each alternative, compare future noise levels (as well as increases in future noise levels over existing noise levels) to appropriate identified noise impact criteria and quantify resulting noise impacts. This information is presented in Section 4 of this report.

5. **Evaluate Noise Abatement:** Where noise impacts are identified, evaluate potential noise abatement measures. Abatement measures are evaluated for feasibility and reasonableness according to FHWA and MDOT standards. This information is presented in Section 5 of this report.

6. **Construction Noise Considerations:** Analyze potential construction noise impacts and discuss available mitigation options. This information is presented in Section 6 of this report.

7. **Information for Public Officials:** Provide or identify appropriate information for local public officials to help avoid future noise impacts. This information is presented in Section 7 of this report.

A more detailed accounting of the specific procedures involved in each of the above analysis steps is provided in the indicated report section.

3.4 Selection of Noise-Sensitive Receptors

In general, noise-sensitive receptors are selected to represent potentially impacted land uses within the project area. A common noise environment (CNE) is generally defined as a group of receptors within the same Activity Category in Table 2-3 that are exposed to similar noise sources and levels; traffic volumes, traffic mix, and speed; and topographic features. Generally, CNEs occur between two secondary noise sources, such as interchanges, intersections, and cross-roads. The delineated CNEs for this project are described in Section 3 of this report. Within each CNE, representative noise measurements and noise prediction locations are identified. Typically, each CNE would have one short-term measurement location and multiple noise prediction locations. The number and locations of the receptors (measurement and modeling locations) within each CNE are selected to adequately represent all the noise-sensitive property units (dwellings) within that CNE, and these properties may include Activity Categories A through E and G in Table 2-3 (including residential, noise sensitive commercial, parks, schools, hotels, and undeveloped lands.). Activity Category F (agriculture, retail, industrial, transportation, and utilities) may still be located within a CNE, but would be considered a noise-compatible land use where a noise analysis is not required. For residential properties, more isolated residences would generally be modeled as individual receptors, while residences in multi-family buildings and dense neighborhoods may be modeled with one modeled receptor location representing multiple dwelling units or homes (receptors).

All noise prediction locations are placed to represent an exterior area of frequent human use. For residential properties, this would normally be an exterior activity area between the structure and the proposed project roadway, such as an exterior patio, deck, pool or play area.

3.5 Loudest Hour Noise Conditions

When determining noise impacts, traffic noise predictions must be made for the loudest noise hour (generally during level of service [LOS] C or D with high heavy truck volumes and speeds close to the posted speed limit or design speed). The loudest hour noise is typically either the peak vehicular truck hour or the peak vehicular volume hour (with LOS A through D conditions).

3.6 Noise Abatement Requirements

According to the FHWA policy and MDOT noise handbook, once a noise impact has been identified, feasible and reasonable noise abatement measures must be considered. For noise abatement, primary consideration is given to the exterior areas of frequent human use.

When traffic noise impacts are identified, noise barrier walls, at a minimum, are required to be considered. In addition to noise walls, other abatement elements may also be considered, if appropriate and applicable, including the following:

- Traffic management measures,
- Alteration of horizontal and vertical alignments,
- Acquisition of property to serve as a buffer to preempt development that would be adversely impacted by traffic noise; and
- Noise insulation (NAC D Only).

When noise barriers are considered, a noise barrier design analysis must show that the barrier is feasible. This typically requires that the barrier provides a minimum required level of noise reduction. According to the MDOT noise handbook, feasible noise barriers must provide at least 5 dBA of noise reduction to at least 75 percent of impacted receptors. In addition to meeting minimum noise reduction requirements, noise barriers must also meet engineering and constructability feasibility requirements in terms of safety, property and emergency access, drainage control, overhead and underground utilities clearance, and other issues.

Noise barrier reasonableness is generally related to cost effectiveness and benefited receptors. The MDOT noise handbook expresses barrier cost effectiveness by a quotient formula called the Cost Per Benefited Receptor Unit (CPBU), which divides the total square-foot cost of the barrier (at a rate of $45/ft^2) by the number of dwelling units that receive benefits. To maintain reasonableness, the total CPBU cannot exceed $49,301 for FY 2021. Barriers must also achieve the MDOT noise reduction design goal of 10 dBA reduction for at least one benefited receptor, and 7dBA reduction at 50 percent of benefitted receptors.

If noise barriers are determined to be reasonable and feasible as defined above, then the viewpoints of property owners and residences should be taken into consideration. Approval by a simple majority (greater than 50 percent) of all responding benefited owners and residences is needed to implement noise abatement. Public votes should occur during final design and could happen during the context sensitive design aesthetic public input phase.

3.7 Noise Modeling Methodology

Future build noise levels, along with existing noise levels, were predicted using the FHWA TNM Version 2.5, the most recent version available at the time of the analysis. All conventional modeling techniques and recommendations for TNM by both FHWA and MDOT were implemented. These included the following modeling procedures and conventions:

- TNM roadways were generally modeled as bundled roadways with no more than three lanes per roadway.
- All roadway pavement types were modeled as “Average.”
- Traffic speeds and volumes for peak traffic hour as provided in the traffic data were modeled to predict worst case noise levels. Traffic speeds and volumes used in this analysis were based on the predicted traffic data included in Table 3-1, below.
- Existing terrain lines (topography) and buildings were modeled where appropriate.
- All TNM model runs were detail checked for accuracy by an independent noise analyst.
- All TNM model runs are available upon request

It is also noted that although the arterial service roads located between the I-496 travel lanes and ramps, MLK Jr. Boulevard, and the residential areas were not part of the project improvements, they are contributing noise sources in the adjacent neighborhoods and so were included in the TNM noise models.

3.8 Project Traffic Data

Predicted traffic data for the existing and future build were provided by MDOT. A summary of the traffic data used for this analysis can be found in Table 3-1.

Table 3-1 Existing and Future Traffic Volumes

	Existing Traffic (vehicles per hour)				Future Traffic (vehicles per hour)			
	2020 Peak Hour				2040 Peak Hour			
	I-496		Frontage Roads[1]		I-496		Frontage Roads[1]	
	EB	WB	EB	WB	EB	WB	EB	WB
Speed (mph) [2]	70/65/65	70/65/65	30/30/30	30/30/30	70/65/65	70/65/65	30/30/30	30/30/30
Total	3,691	3,407	1,565	1,462	4,120	3,803	1,738	1,623
Auto and Light Trucks	3,601	3,324	1,527	1,426	4,020	3,710	1,696	1,584
Medium Duty Trucks	47	43	20	19	53	48	22	21
Heavy Duty Trucks	43	39	18	17	48	44	20	19

Notes:
1. Frontage roads include St. Joseph Street and Malcom X Street.
2. Modeled speeds are for autos/medium trucks/heavy trucks
Source: MDOT Traffic Memo

3.9 Existing Condition and Common Noise Environments

3.9.1 Existing Land Use and Zoning

Land uses within the project study area are a mix of residential (single and multi-family), commercial, industrial, and undeveloped land. Undeveloped areas in CNE-4 and CNE-8 appear to be former commercial or industrial land uses.

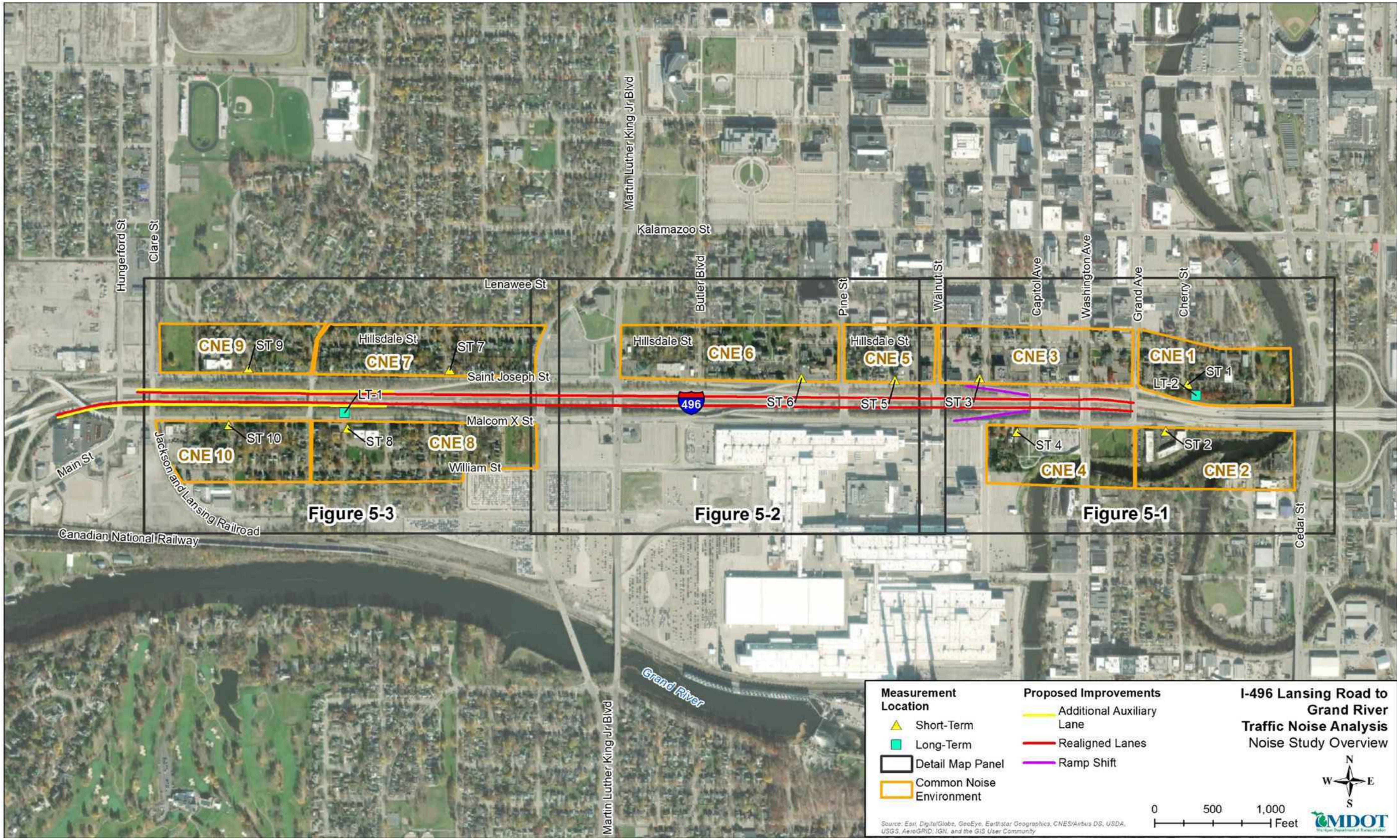
3.9.2 Common Noise Environments

To better categorize the potential noise impacts and evaluate noise abatement for the various project alternatives, all the potentially impacted, noise-sensitive receptors have been organized into CNEs. A CNE is defined as an area containing land uses that share a common highway traffic noise influence. Descriptions of delineated CNEs, including location, primary land use and type of noise-sensitive receptors, are listed in Table 3-2. Figure 3-2 shows an overview of the project area illustrating all the defined CNEs.

Table 3-2 Common Noise Environments

CNE	Description	Land Use	Measurement ID
CNE-1	Area north of I-496, between Grand Avenue and the Grand River	Single-family residential, commercial, park	ST-1, LT-2
CNE-2	Area south of I-496, between Grand Avenue and the Grand River	Multi-family residential, park	ST-2
CNE-3	Area north of I-496, between Walnut Street and Grand Avenue	Commercial, single-family residential	ST-3
CNE-4	Area south of I-496 between Townsend Street and Grand Avenue	Park, historical buildings, undeveloped	ST-4
CNE-5	Area north of I-496, between Pine Street and Walnut Street	Commercial, single-family residential	ST-5
CNE-6	Area north of I-496, between northbound MLK Jr. Boulevard and Pine Street	Single and multi-family residential, commercial	ST-6
CNE-7	Area north of I-496, between Everett Drive and northbound MLK Jr. Boulevard	Single-family residential, church parking lot	ST-7
CNE-8	Area south of I-496, between Everett Drive and southbound MLK Jr. Boulevard	Single-family residential, undeveloped, churches, school	ST-8
CNE-9	Area north of I-496, between Clare Street and Everett Drive	Single-family residential, school, park	ST-9
CNE-10	Area south of I-496, between Clare Street and Everett Drive	Single-family residential, industrial	ST-10, LT-1

Figure 3-2 Common Noise Environments and Noise Measurement Sites



3.9.3 Existing Noise Environment

3.9.3.1 Field Noise Measurements

Multiple noise measurements were conducted for this project on Oct. 21-23, 2020. Noise measurements were conducted to provide information for noise model validation (short-term measurements with accompanying classified traffic counts) and to establish the loudest traffic noise hour. Noise measurements were conducted as described in Section 2.3. Appendix A includes measurement-related materials.

A total of 10 short-term noise measurements were conducted as summarized in Table 3-3. Figure 3-2 contains an aerial figure of the project area showing each measurement location.

3.9.3.2 Noise Model Validation and Results

The FHWA TNM Version 2.5 (TNM) was used to predict noise levels for the future build alternative as well as existing noise levels at receptor locations where noise levels are dominated by traffic noise on project roadways. To demonstrate that the noise model is predicting noise levels within a reasonable margin of error, the noise model runs are validated by comparing predicted noise levels to measured noise levels for similar traffic conditions. However, since the TNM only predicts noise levels associated with traffic noise, the model runs can only be validated at measurement locations where current noise levels are dominated by project roadways. For this project, noise model validation was possible for all six short-term noise measurement locations. Noise models are considered to be validated if the difference between measured and modeled noise levels for comparable conditions is 3 dBA or less. The successful results of the noise validation effort are presented in Table 3-3.

Table 3-3 TNM Validation Summary

Measurement ID and Location	Traffic			Measured Leq, dBA	Modeled Leq, dBA	Difference
ST-1, 621 Cherry Street	**Type**	**EB I-496**	**WB I-496**	66.7	65.9	-0.8
	Auto	1,156	1044			
	Medium Truck	24	4			
	Heavy Truck	44	48			
ST-2, 300 E Main Street	**Type**	**EB I-496**	**WB I-496**	70.7	71.9	+1.2
	Auto	1,035	1,418			
	Medium Truck	34	23			
	Heavy Truck	71	83			
ST-3, 330 West Joseph Street	**Type**	**EB I-496**	**WB I-496**	68.9	67.9	-1.0
	Auto	1,592	1,440			
	Medium Truck	4	12			
	Heavy Truck	32	40			
ST-4, 213 W Malcom X Street	**Type**	**EB I-496**	**WB I-496**	64.8	66.3	+1.5
	Auto	1,540	132			
	Medium Truck	36	12			
	Heavy Truck	44	20			
ST-5, 426 W St Joseph Street	**Type**	**EB I-496**	**WB I-496**	69.2	67.7	-1.5
	Auto	1,828	1,608			
	Medium Truck	8	28			
	Heavy Truck	24	24			
ST-6, 600 W St Joseph Street	**Type**	**EB I-496**	**WB I-496**	70.3	68.9	-1.4
	Auto	1,508	696			
	Medium Truck	20	16			
	Heavy Truck	52	36			
ST-7, 623 S Jenison Avenue	**Type**	**EB I-496**	**WB I-496**	68.9	66.0	-2.9
	Auto	1,560	1,068			
	Medium Truck	0	60			
	Heavy Truck	60	24			
ST-8, 1715 W Malcom X Street	**Type**	**EB I-496**	**WB I-496**	61.6	62.6	+1.0
	Auto	1,216	588			
	Medium Truck	52	16			
	Heavy Truck	68	48			
ST-9, 2101 Bruce Avenue	**Type**	**EB I-496**	**I-496**	65.8	64.4	-1.4
	Auto	1260	816			
	Medium Truck	0	12			
	Heavy Truck	36	24			
ST-10, 2109 Malcolm X Street	**Type**	**EB I-496**	**WB I-496**	63.2	63.2	0.0
	Auto	408	768			
	Medium Truck	0	24			
	Heavy Truck	0	12			

As shown in Table 3-3, all calculated differences between modeled and measured noise levels are less than 3 dBA, therefore the noise models in those locations are considered validated.

TNM validation runs developed for this project are digitally archived and will be made available upon request.

4. Noise Impact Analysis

4.1 Future Noise Levels and Impacts

This section presents predicted noise levels and noise impacts (or noise impact distances for both identified CNE areas and general undeveloped areas).

4.1.1 Predicted Noise Levels and Noise Impacts

Traffic noise impacts, as defined in 23 CFR 772.5, occur when the design year condition noise levels approach or exceed the noise abatement criteria (NAC) specified in 23 CFR 772, or design year condition noise levels create a substantial noise increase over existing noise levels. 23 CFR 772 does not specifically define the terms “substantial increase” or “approach;” these criteria are defined in the MDOT Noise Analysis and Abatement Guidelines (July 13, 2011), as described in the following section. Table 2-3 summarizes the FHWA NAC corresponding to various defined land use activity categories.

The MDOT noise handbook defines that a noise impact occurs when the sound level approaches or exceeds the NAC level, which is defined as an Leq(h) sound level 1 dBA less than the NAC identified in 23 CFR 772. This means that a peak hour noise level of 66 dBA is considered to approach the NAC for Category B of 67 dBA and is identified as an impact, but 65 dBA does not. The MDOT noise handbook defines a noise increase as substantial when the predicted traffic noise levels with project implementation exceed existing noise levels by 10 dBA.

Future build alternative noise levels, along with existing noise levels, were predicted using the FHWA TNM Version 2.5. All conventional modeling techniques and recommendations for TNM by both FHWA and MDOT were implemented, as described in Section 3.7.

Table 4-1 below contains a summary of the predicted noise levels and noise impacts at all modeled CNE locations in the project. Figures 5-1 (CNE-1, CNE-2, CNE-3 and CNE-4), 5-2 (CNE-5 and CNE-6), and 5-3 (CNE-7, CNE-8, CNE-9 and CNE-10) contain detailed aerial-based figures of the project area showing all modeled receptor locations and predicted future build impacts. Due to the large number of modeled receptors and CNEs within the project area, prediction information for individual receptors is presented in detail in Appendix C.

Table 4-1 Summary of Predicted Noise Levels by CNE

CNE	No. of Modeled Receptors	Total Dwelling Units	Predicted Noise Level (Range), Leq (1h)		Total Number of Noise Impacted Units		
			Existing	Future Build	Approach or Exceed NAC	Significant Increase	Total Impacted DU
CNE-1	46	46	53.0 - 70.5	53.6 - 71.8	12	0	12
CNE-2	15	15	53.5 - 67.1	54.0 - 68.3	4	0	4
CNE-3	6	6	47.0 - 65.9	47.8 - 66.3	0	0	0
CNE-4	7	7	55.1 - 67.2	55.6 - 67.5	2	0	2
CNE-5	15	15	50.7 - 69.4	51.2 - 69.9	5	0	5
CNE-6	116	116	47.0 - 71.8	47.4 – 72.0	28	0	28
CNE-7	66	66	48.4 - 73.6	48.6 - 74.1	35	0	35
CNE-8	56	57*	48.5 - 71.6	48.8 - 71.6	16	0	16
CNE-9	26	26	48.6 - 68.2	49.0 - 68.4	9	0	9
CNE-10	24	24	47.6 - 67.9	48.0 - 68.3	10	0	10
*Note: CNE 8 contains an Activity Category C land use for which analysis determined 2 DUEs for receptor 08-02 for the purpose of cost-effectiveness calculation in determining reasonableness. Other Activity Category C land uses were deemed inapplicable for additional DUEs.							

Figures showing all receiver locations along with evaluated noise abatement elements are included in section 5.

5. Noise Abatement Evaluation

5.1 Noise Abatement Measures

According to FHWA and MDOT policies, when noise impacts are identified, noise barriers (at a minimum) must be considered as noise abatement. Other potential noise abatement measures might include heavy truck or speed restrictions, alignment changes, and depressed roadways. Of these alternatives, the project alignment was evaluated and compared for noise impacts (as presented in section 4), but truck restrictions and speed restrictions below proposed speed limits would significantly reduce the value of the roadway. Noise barriers were evaluated for each CNE with noise impacts for feasibility and reasonableness. The following section describes the results of the barrier assessments for each evaluated CNE.

5.2 Feasible and Reasonable Criteria and Requirements

In order for mitigation to be recommended, the barrier must meet certain feasibility and reasonableness requirements established by MDOT in the Noise Analysis and Abatement Guidelines.

When noise barriers are considered, a preliminary noise barrier design analysis must show that the barrier is feasible. According to the MDOT noise handbook, feasible noise barriers must provide at least 5 dBA of noise reduction to 75 percent of the impacted receptors. In addition to meeting minimum noise reduction requirements, noise barriers must also meet engineering and constructability feasibility requirements in terms of safety, property and emergency access, drainage control, overhead and underground utilities clearance, and other issues.

Noise barrier reasonableness is generally related to cost effectiveness and benefited receptors, where a benefited receptor receives at least 5 dBA of noise reduction (NR), and cost effectiveness is driven by a Cost per Benefited Receptor Unit (CPBU) value. The handbook identifies a CPBU of $49,301 for FY 2021, which is a final quotient resulting from dividing the total cost of abatement (at a rate of $45 feet^2) by the total number of benefited receptors. Additionally, The MDOT design year attenuation requirement requires that a minimum of one benefited receptor achieve a 10 dBA noise reduction, and that 50 percent of benefited receptors must achieve a 7 dBA reduction for noise abatement to be reasonable.

To summarize, for a barrier to be considered feasible and reasonable, it must have:

- A noise reduction of at least 5 dBA must be achieved at 75 percent of impacted receptors.
- A noise reduction of 10 dBA must be achieved for at least one receptor.
- A noise reduction of 7 dBA must be achieved at 50 percent of benefitted receptors.

For a noise barrier to be considered reasonable in addition to the requirements listed above, the viewpoints of benefited property owners and residents must be taken into consideration. Greater than 50 percent in favor of all responding benefited owners and residents is needed to build noise abatement. Public viewpoints and votes of benefited receptors are not part of this noise analysis but are collected during the preliminary engineering phase and are recorded in the environmental documentation.

5.3 Findings and Recommendations for Noise Abatement

Noise abatement was considered for each CNE with identified noise impacts. Initially, noise abatement was checked for feasibility (5 dBA reduction and at least 75 percent of impacted receptors and access restrictions). If abatement was determined to be feasible, the abatement was analyzed for cost effectiveness and other reasonableness factors. For all impacted receptors meeting feasibility requirements, preliminary barrier designs were evaluated using TNM. If the abatement was found to be both reasonable and feasible, it would be recommended for inclusion in the project pending a polling of viewpoints from benefited receptors. A summary of the barrier's locations and resulting sound levels are provided in Table 5-1. The details of the barrier analysis, including feasibility and reasonableness results, are included in Table 5-2. The narrative results of abatement evaluations for each impacted CNE are summarized in subsequent sub-sections.

Table D-1 in Appendix D lists the existing and predicted future build noise levels as well as the noise levels with barrier per modeled receptor location. The table also includes the information in regard to benefited receptors and barrier design goal achievement.

Table 5-1 Noise Wall Descriptions

Barrier ID	Location	Existing Leq (dBA)	Future Leq Range (dBA)		Noise Reduction (dBA)	Barrier Descriptions (feet)	
			No Wall	With Wall		Length	Avg Height
Wall 1	Directly north of the westbound I-496 off ramp between the Grand River bridge and Grand Avenue	53-70	54-70	53-68	0-10	677	18
Wall 2	North of Malcom X Street between Grand Avenue and the Grand River bridge	54-67	54-68	54-68	0-5	436	20
Wall 4	North of Malcom X Street between Walnut Street and Capitol Avenue	55-67	56-68	55-64	0-4	803	20
Wall 5	South of St. Joseph Street between Pine Street and Walnut Street	51-70	51-70	50-69	0-3	649	20
Wall 6	South of St. Joseph Street between MLK Jr. Boulevard and Pine Street	47-72	47-72	47-70	0-11	662	18
Wall 7	South of St. Joseph Street between Everett Drive and MLK Jr. Boulevard	48-74	48-74	48-71	0-7	1,952	20
Wall 8	North of Malcom X Street between Everett Drive and MLK Jr. Boulevard	49-72	49-72	48-68	0-8	1,950	20
Wall 9	South of St. Joseph Street between Clare Street and Everett Drive	49-68	49-68	49-66	0-4	1,186	20
Wall 10	North of Malcom X Street between Clare Street and Everett Drive	49-68	49-68	47-66	0-6	1,228	20

Table 5-2 Barrier Analysis Results

Barrier ID	Number of Attenuated Locations					Cost	Cost/Benefitted	Feasible	Reasonable	Recommended
	≥ 10 dBA	≥ 7 dBA		≥ 5 dBA (Benefitted Receptors*)						
		#	% of Benefit	#	% of Impacted					
Wall 1	1	6	55%	11	75%	$540,630.00	$49,148.18	Yes	Yes	Meets Criteria
Wall 2	0	0	0%	3	0%	$392,445.00	$130,815.00	No	No	No
Wall 4	0	0	-	0	0%	$723,330.00	-	No	No	No
Wall 5	0	0	-	0	0%	$584,145.00	-	No	No	No
Wall 6	6	15	65%	23	54%	$536,265.00	$23,315.87	No	Yes	No
Wall 7	0	13	41%	32	69%	$1,757,295.00	$54,915.47	No	No	No
Wall 8	0	10	43%	23	69%	$1,757,340.00	$76,407.09	No	No	No
Wall 9	0	0	-	0	0%	$1,067,445.00	-	No	No	No
Wall 10	0	0	0%	10	60%	$1,105,380.00	$110,538.00	No	No	No

*Note: Not all benefitted receptors are impacted. % of impacted was calculated using only those receptors that were both impacted and received benefit.

5.3.1 CNE-1 Noise Abatement Analysis

CNE-1 contains 46 modelled receptors representing 45 single-family residences and one park. Twelve receptors were determined to be impacted under future build conditions, and a DUE calculation for the park was deemed inapplicable for the cost-effectiveness portion of the reasonableness determination since benefits do not reach the park. A barrier was analyzed along the westbound I-496 off ramp, Wall 1. The western terminus of the wall at this location was limited slightly in order to maintain the viewshed for a historic building in that area at the request of the State Historic Preservation officer. Wall 1 was found to meet MDOT feasibility and reasonableness standards. This barrier is shown in Figure 5-1 and detailed analysis metrics can be found in Tables 5-1 and 5-2.

5.3.2 CNE-2 Noise Abatement Analysis

CNE-2 contains 15 modelled receptors representing two multi-family complexes and one park. Four receptors were determined to be impacted under future build conditions, and a DUE calculation for the park was deemed inapplicable for the cost-effectiveness portion of the reasonableness determination since benefits do not reach the park. A barrier was analyzed north of Malcom X Street, Wall 2. Wall 2 failed to meet MDOT feasibility requirements, as no impacts received a 5 dB reduction. Thus, this barrier is not recommended. This barrier is shown in Figure 5-1 and detailed analysis metrics can be found in Tables 5-1 and 5-2.

5.3.3 CNE-3 Noise Abatement Analysis

CNE-3, shown in Figure 5-1, contained no impacted receptors; thus, no abatement was considered.

5.3.4 CNE-4 Noise Abatement Analysis

CNE-4 contained seven modelled receptors representing various public outdoor spaces, all activity category C. Two of these receptors were found to be impacted, and a DUE calculation was deemed inapplicable for the cost-effectiveness portion of the reasonableness determination since no benefits reach the receptors. A barrier was considered north of Malcom X Street (with a gap for the eastbound on ramp). This barrier (Wall 4) failed to meet MDOT feasibility requirements, as no receptors received a 5 dB noise reduction. Thus, this barrier is not recommended. This barrier is shown in Figure 5-1 and detailed analysis metrics can be found in Tables 5-1 and 5-2.

5.3.5 CNE-5 Noise Abatement Analysis

CNE-5 contains 15 modelled receptors representing 15 single-family residences. Five of these receptors were found to be impacted. A barrier was analyzed south of St. Joseph Street, but failed to meet MDOT feasibility standards as no receptors received a 5 dB noise reduction. This barrier is not recommended. This barrier is shown in Figure 5-2 and detailed analysis metrics can be found in Tables 5-1 and 5-2

5.3.6 CNE-6 Noise Abatement Analysis

CNE-6 contains 116 modelled receptor units representing 115 single-family residences and multi-family dwelling units, as well as one park. Twenty-eight receptors were found to be impacted, and a DUE calculation was deemed inapplicable for the cost-effectiveness portion of the reasonableness determination since no benefits reach the park. A barrier system south of St. Joseph Street was modelled that determined to meet acoustic performance requirements; however, this barrier was found to be not feasible due to constructability and safety issues along the shoulder of St. Joseph Street (not constructable due to lack of room to build a noise wall between St. Joseph Street and the existing retaining wall, along with unsafe driving conditions due to obstruction of sight). Thus, the barrier is not feasible and is not recommended. This analyzed barrier location is shown in Figure 5-2 and detailed analysis metrics can be found in Tables 5-1 and 5-2.

5.3.7 CNE-7 Noise Abatement Analysis

CNE-7 contains 66 modelled receptors representing 66 single-family residences and dwelling units. Thirty-five of these receptors were found to be impacted, and a barrier was analyzed south of St. Joseph Street with a gap for the westbound on ramp. This barrier achieved 5 dB of reduction at 69 percent of impacted receptors, failing to meet the 75 percent requirement for MDOT feasibility. Thus, this barrier is not recommended. This barrier is shown in Figure 5-3 and detailed analysis metrics can be found in Tables 5-1 and 5-2.

5.3.8 CNE-8 Noise Abatement Analysis

CNE-8 contains 56 receptors representing 51 single-family residences, one school (four receptors), and one church. Sixteen of these receptors were found to be impacted, and a DUE calculation for the northern school receptor was calculated for the cost-effectiveness portion of the reasonableness determination. Other activity category C receptors were deemed inapplicable for a DUE calculation since benefits do not reach the receptors south of the school, and the benefited area of the church is less than the area of a typical residential lot. A barrier was analyzed north of Malcom X Street with a gap for the eastbound off ramp. This barrier achieved 5 dB of reduction at 69 percent of impacted receptors, failing to meet the 75 percent requirement for MDOT feasibility. Thus, this barrier is not recommended. This barrier is shown in Figure 5-3 and detailed analysis metrics can be found in Tables 5-1 and 5-2.

5.3.9 CNE-9 Noise Abatement Analysis

CNE-9 contains 26 receptors representing 24 single-family residences, one school, and one park. Nine of these receptors were found to be impacted, and a DUE calculation was deemed inapplicable for the cost-effectiveness portion of the reasonableness determination since no benefits reach either activity category C receptor. A barrier was analyzed south of St. Joseph Street. This barrier achieved 5 dB of reduction at 0 percent of impacted receptors. This fails to meet the 75 percent requirement for MDOT feasibility; thus, the barrier is not recommended. This barrier is shown in Figure 5-3 and detailed analysis metrics can be found in Tables 5-1 and 5-2.

5.3.10 CNE-10 Noise Abatement Analysis

CNE-10 contains 24 receptors representing 24 single-family residences. Ten of these receptors were found to be impacted, and a barrier was analyzed north of Malcom X Street. This barrier achieved 5 dB of reduction at 60 percent of impacted receptors. This fails to meet the 75 percent requirement for MDOT feasibility; thus, the barrier is not recommended. This barrier is shown in Figure 5-3 and the detailed analysis metrics can be found in Tables 5-1 and 52.

Figure 5-1 Acoustical Analysis for CNE-1, CNE-2, CNE-3, and CNE-4

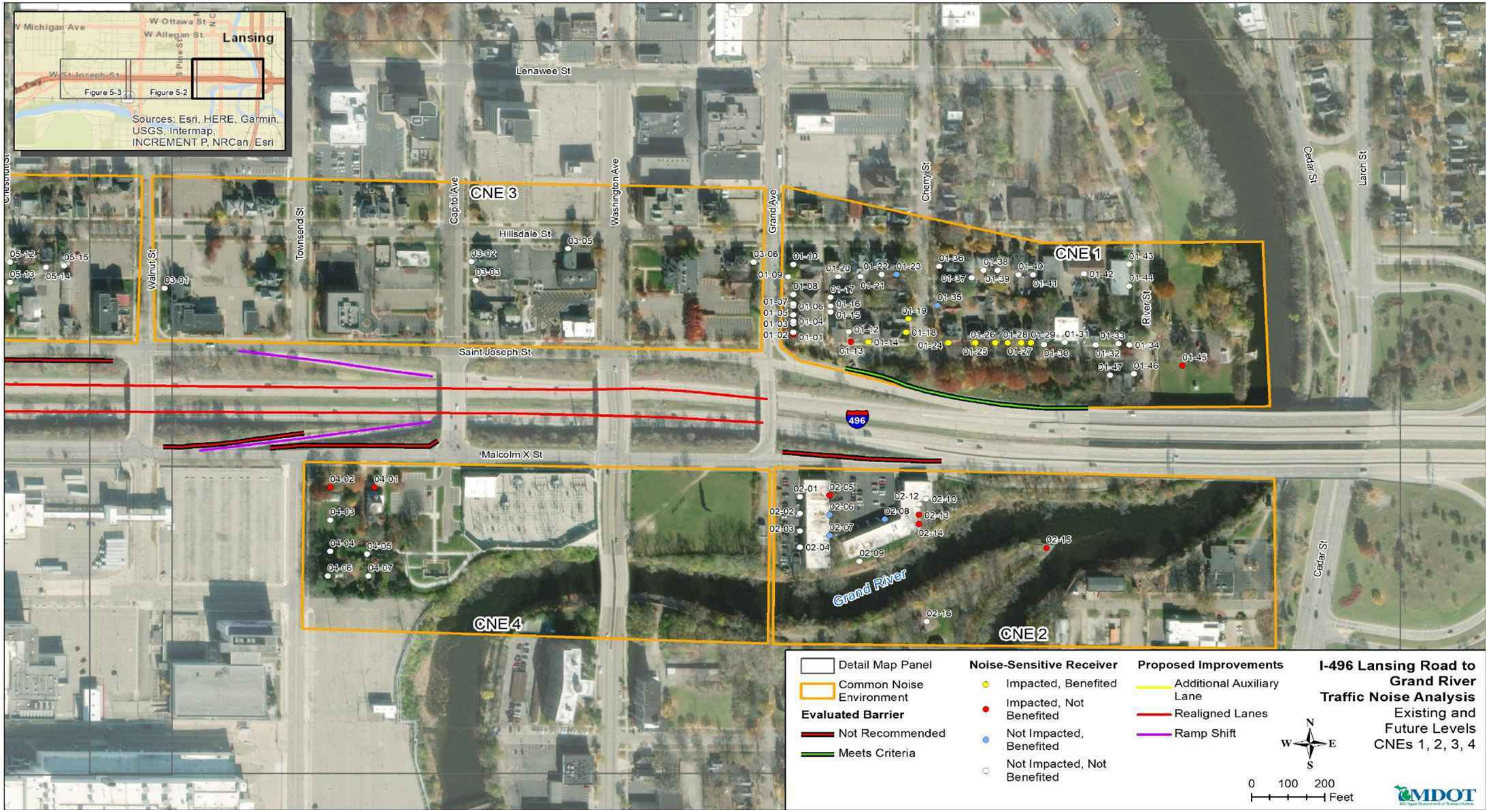


Figure 5-2 Acoustical Analysis for CNE-5 and CNE-6

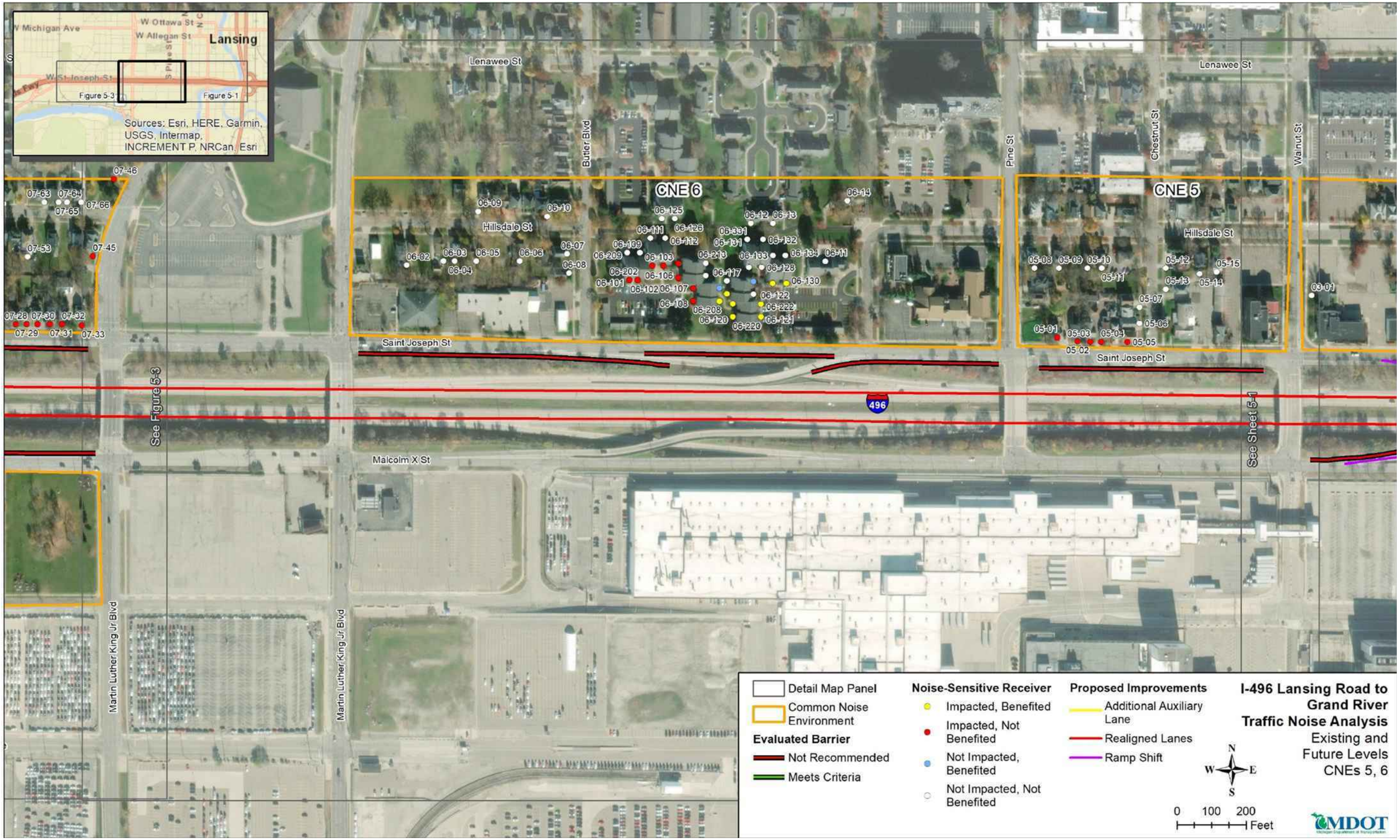
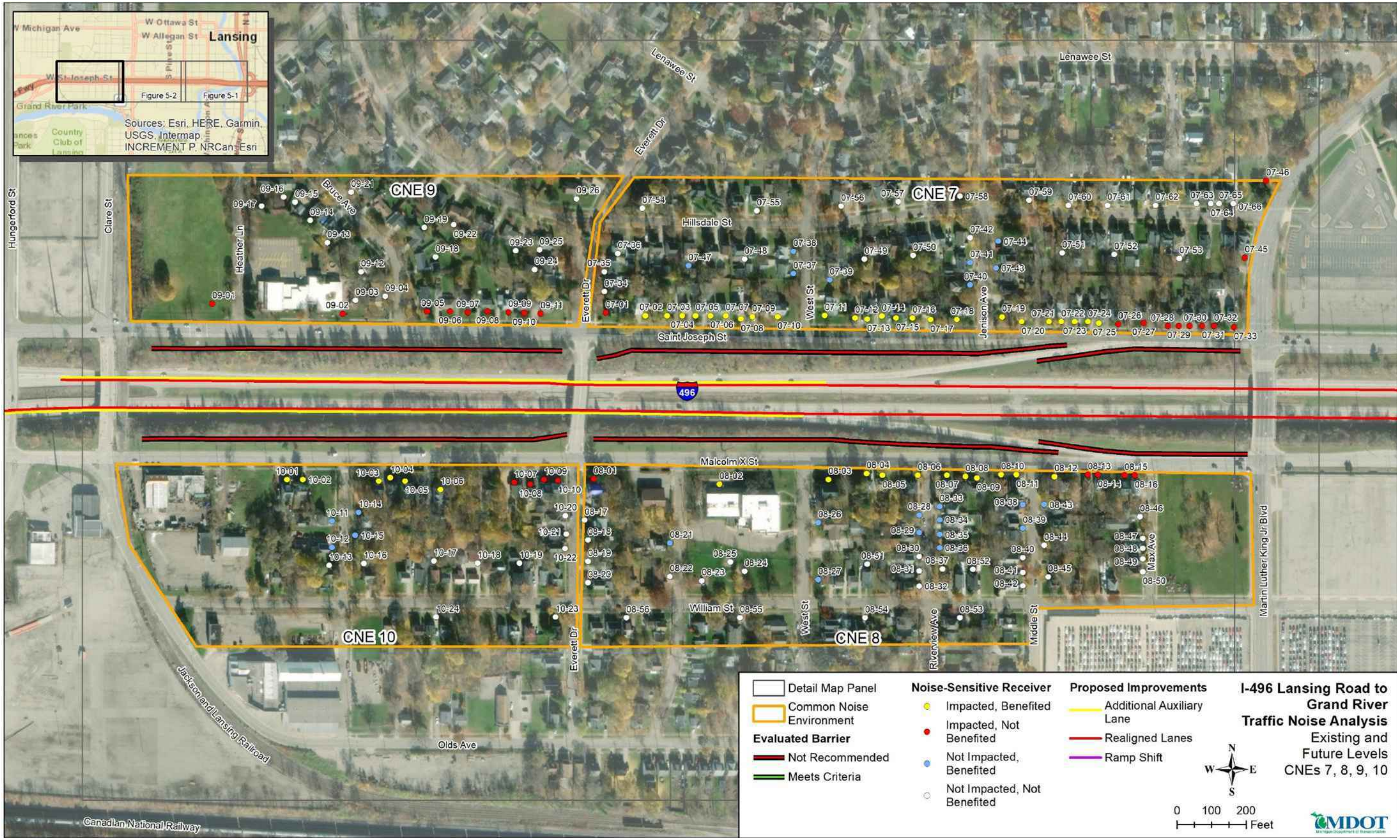


Figure 5-3 Acoustical Analysis for CNE-7, CNE-8, CNE-9 and CNE-10



6. Construction Noise Analysis

FHWA policy requires that construction noise be considered in a Type 1 highway noise analysis. This analysis would generally include the following:

1. Identification of land uses that may be affected by construction noise,
2. Determination of the measures needed in the plans and specifications to minimize or eliminate construction noise impacts; and,
3. Incorporate needed abatement into the plans and specifications.

Neither FHWA nor MDOT identify specific construction noise impact criteria. In addition, the detailed information required to predict actual construction noise levels (construction schedules, phasing, equipment lists, laydown areas, etc.) has not yet been determined. However, for this project it is anticipated that pile driving and some nighttime construction work will be required.

It is recognized that areas adjacent to the highway right of way and other construction areas (such as staging areas and laydown sites) can temporarily be exposed to high levels of noise during peak construction periods. It is reasonable to assume that the same CNEs identified for potential traffic noise impacts could also be exposed to construction noise. The effect of the noise on the local area can be reduced if the hours and days of construction activity are limited to less sensitive time periods. The project construction standard noise specifications help minimize the effects of construction noise.

The following special provisions may be incorporated into the construction contract:

- Inform the local public in advance of construction activities that may generate particularly high noise levels (such as pile drivers) or periods of nighttime construction activity.
- Noise barriers, approved for incorporation into the project, should be built as close to the beginning of the project's construction timeline as practical.
- Noise created by truck movement shall not exceed 88 dBA at a distance of 50 feet.
- When working between 7 p.m. and 10 p.m., use “smart alarms” instead of standard reverse signal alarms or use spotters. When working between 10 p.m. and 7 a.m., use spotters.
- Have portable noise meters on the job at all times for noise level spot checks on specific operations. Employ an individual trained in the use of noise meters, with working knowledge of sound measurements and their meaning and use as applied to these mitigation/abatement measures.

6.1 Typical Construction Noise Levels

Table 6-1 contains a list of commonly used construction equipment and noise levels associated with using that equipment.

Table 6-1 Typical Construction Equipment Noise Levels

Equivalent Type	Lmax at 50 feet (dBA)	AUF* (%)
Auger Drill	84	20
Backhoe	78	40
Boring Jack Power Unit	83	50
Chain Saw	84	20
Compactor (ground)	83	20
Compressor (air)	78	40
Concrete Mixer Truck	79	40
Concrete Pump Truck	81	20
Concrete Saw	90	20
Crane	81	16
Dozer	82	40
Drill Rig Truck	79	20
Drum Mixer	80	50
Dump Truck	76	40
Excavator	81	40
Flat Bed Truck	74	40
Front End Loader	79	40
Generator (>25KVA)	81	50
Generator (<25KVA)	73	50
Gradall	83	40
Grader	85	40
Horizontal Boring Jack	82	25
Hoe Ram	90	20
Jackhammer	89	20
Man Lift	75	20
Pavement Scarifier	90	20
Paver	77	50
Pickup Truck	75	40
Pneumatic Tools	85	50
Pumps	81	50
Roller	80	20
Scraper	84	40
Shears (on backhoe)	96	40
Tractor	84	40
Vacuum Excavator	85	40
Vacuum Street Sweeper	82	10
Ventilating Fan	79	100
Vibrating Hopper	87	50
Vibratory Concrete Mixer	80	20
Warning Horn	83	5
Welder/Torch	74	40

*AUF = Acoustical Usage Factor
Source: RCNM User Guide, Table 1 (actual measured Lmax)

6.2 Construction Noise Abatement Measures

Although MDOT does not identify any specific abatement measures related to construction noise, the following list could be considered best practices for the avoidance of any potential problems related to construction noise impacts:

- No construction shall be performed within 1,000 feet of an occupied dwelling unit on Sundays, legal holidays, or between the hours of 10 p.m. and 6 a.m. on other days without the approval of the MDOT construction project manager.
- All equipment used shall have sound-control devices no less effective than those provided on the original equipment. No equipment shall have unmuffled exhaust.

- All equipment shall comply with pertinent equipment noise standards of the U.S. Environmental Protection Agency.
- No pile driving or blasting operations shall be performed within 3,000 feet of an occupied dwelling unit on Sundays, legal holidays, or between the hours of 8 p.m. and 8 a.m. on other days without the approval of the MDOT construction project manager.
- The noise from rock crushing or screening operations performed within 3,000 feet of any occupied dwelling shall be mitigated by strategic placement of material stockpiles between the operation and the affected dwelling or by other means approved by the MDOT construction project manager.

If a specific noise impact complaint is received during construction of the project, the contractor may be required to implement one or more of the following noise mitigation measures at the contractor's expense, as directed by the construction project manager:

- Locate stationary construction equipment as far from nearby noise-sensitive properties as feasible (preferably towards the east end of the project, further from sensitive receivers).
- Shut off idling equipment.
- Reschedule construction operations to avoid periods of noise annoyance identified in the complaint.
- Notify nearby residents whenever extremely noisy work will be occurring.
- Install temporary or portable acoustic barriers around stationary construction noise sources.
- Operate electrically powered equipment using line voltage power or solar power.

7. Information for Local Government Officials

FHWA and MDOT policy specify that local officials should be provided appropriate information to assist with future compatible land use planning, especially about the future planning and development of currently undeveloped lands near the proposed project right of way. There are two identified undeveloped areas in the project study area, one in CNE-4, and one in CNE-8, both of which appear to be former commercial/industrial land uses.

Table 7-1 shows noise impact distance for the 66 dB and 71 dB levels (NAC categories B/C and E, respectively) from I-496 in the project area. Future developments should not place applicable noise sensitive land uses within the distances listed from Edge of Pavement.

Table 7-1 Noise Impact distances for undeveloped lands

Project Roadway	Distance from the Edge of Pavement	
	71 dB Distance	66 dB Distance
I-496	192 feet	268 feet

8. Conclusions and Recommendations

The noise analysis for the proposed project included a total of 12 measurement locations and 376 predicted representative noise levels for 376 dwelling units in the project area. The project was split into 10 separate CNEs for noise impact analysis within the study area.

Nine of the 10 CNEs contained receptors with predicted future noise levels approaching or exceeding the NAC. Noise abatement was considered in nine locations. One of these barriers were found to be feasible and reasonable. The remaining eight were disqualified for failing to meet either or both feasibility and reasonableness requirement as defined by MDOT policy. The barrier in CNE 1 meets MDOT criteria. This barrier would be advanced to the public participation phase to determine viewpoints of benefited receptors for final determination of reasonableness and inclusion in the project.

9. Statement of Likelihood

Based on the studies thus far accomplished, MDOT intends to install highway traffic noise abatement in the form of barriers presented in Table 5-1 in this document. The preliminary indications of likely abatement measures are based on preliminary design for barrier cost(s) and noise abatement as illustrated in Table 5-2 in this document. If it subsequently develops during final design that these conditions have substantially changed, the abatement measures might not be provided. A final decision of the installation and aesthetics of the abatement measures(s) will be made upon completion of the project's final design and the Context Sensitive Design process.

10. References

Federal Highway Administration, 23 CFR 772, Procedures for Abatement of Highway Traffic Noise and Construction Noise, July 2010. https://www.fhwa.dot.gov/legsregs/directives/fapg/cfr0772.htm

Federal Highway Administration (FHWA). 2011. Highway Traffic Noise: Analysis and Abatement Guidance. U.S. Department of Transportation, Federal Highway Administration, Washington, D.C. https://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/revguidance.pdf

Michigan Department of Transportation, Highway Noise Analysis and Abatement Handbook. July 13, 2011. https://www.Michigan.gov/Documents/MDOT/MDOT_HighwayNoiseAnalysis_and_AbatementHandbook_358156_7.pdf

Appendix A: Noise Measurement Data and Documentation

Appendix A contains the following information:
- Noise measurement short-term data summary table
- Noise measurement photo log
- Noise measurement field data sheets

Short Term Measurement Summa

	Location	*Average Leq (dBA)*	*Leq Range (dBA)*	*Start (hh:mm)*	*Stop (hh:mm)*	*Duration (hh:mm)*
ST-1	621 Cherry Street Front Sidewalk	66.7	65.3-67.8	14:50	15:06	00:16
ST-2	300 E Main Street Parking Lot	70.7	69.0-72.3	11:45	12:01	00:16
ST-3	330 St. Joseph Street Parking Lot	68.9	67.3-72.7	16:23	16:39	00:16
ST-4	213 Malcom X Street Driveway	64.8	63.6-65.9	14:14	14:29	00:15
ST-5	426 St. Joseph Street Sidewalk	69.2	67.2-71.2	16:52	17:08	00:16
ST-6	600 St. Joseph Street Sidewalk	70.3	67.7-74.2	13:38	13:53	00:15
ST-7	623 Jenison Avenue Sidewalk	68.9	66.4-70.8	17:26	17:41	00:15
ST-8	1715 Malcom X Street Sidewalk	61.6	60.1-63.5	13:02	13:18	00:16
ST-9	2101 Bruce Avenue Sidewalk	65.8	63.3-68.7	17:53	18:08	00:15
ST-10	2109 Malcom X Street Vacant Lot	63.2	59.3-65.6	18:21	18:36	00:15

Noise Measurement Photo Log

LT-01 Near Malcom X Street and Nipp Avenue


LT-01 Facing East


LT-01 Facing West

LT-02 Near St. Joseph Street and Cherry Street


LT-02 Facing Southeast


LT-02 Facing Southwest

ST-01 621 Cherry Street


ST-01 Facing South


ST-01 Facing North

ST-02 300 E Main Street

ST-02 Facing Northeast

ST-02 Facing Southeast

ST-03 Townsend Street and St. Joseph Street

ST-03 Facing Southwest

ST-03 Facing Northeast

ST-04 213 Malcom X Street

ST-04 Facing Northeast

ST-02 Facing Southwest

ST-05 Chestnut Street and St. Joseph Street

ST-05 Facing Southeast

ST-05 Facing Northwest

ST-06 Sycamore Street and St. Joseph Street

ST-06 Facing North

ST-06 Facing Southwest

ST-07 623 Jenison Avenue

ST-07 Facing North

ST-07 Facing Southeast

ST-08 1715 Malcolm X Street

ST-08 Facing South

ST-08 Facing North

ST-09 2101 Bruce Avenue

ST-09 Facing North

ST-09 Facing South

ST-10 2101 Bruce Avenue

ST-10 Facing North

ST-10 Facing South

Field Data Sheets

AECOM Acoustics and Noise Control Practice
FIELD NOISE MEASUREMENT DATA FORM

Project Name: plperr I-06 Lasing Project e: Date: :O/2, i 4,0 to page of

Measurement Location: VT—I Analyst: vi.L 5 •

So Level Meter	Feld Carnation	Iiteembolcel Data
Model A c	Model*: o	Model A: k3,5 OO
Sonata: g).(01	Serial	Serial St I. 0 s83 O3 14;5 1-
Weighting A / Rat Response:0o I Fast! Invp4 Vandsaraen. es No (ro0ain)	Calbratim Level (dB): 94 114 Post-Test r--rD i di '.	Precipitation: Yes (explain) ,e, Wind: Steady I Gusty / Calm Avg Nand Speed/Dlrecdon: . . ,?,3 nth 1
Tam Flat / Hilly	BPS Coordinates fat SLM locaani	Temp (7): I RH(%): .g
Terrain: Hard/Soft ft Mixed / A(a) /Snow		Bar Par (Ng): r & thud Detti(A): 9

Lcc. ID	Stan Time	Slop Time (hh:mm)	Metrics 41	L,,r.	1...	Statistics Le	Lso	le	Nolea/Evenbs
	4 4								
	I -T								V S V C41
	S't'				' 7				

Roadway			220011
Speed (posVobe)			C)
Number of Lanes			r 496
Width (pave/row)			
	1- or 2- way		
Grade			
Bus Stops			
Stoplights			
Motorcycles			
Automobiles			
Medium Trucks			
Heavy Trucks			
Buses			
Count duration			

Site Diagram:

— .....
----2,
„<,..--- ---z ,--/
/7 ' ..________./ ,,..„.„
......7i
Jr..011 _.—. .....
-- ILL i.siqi

Additional Note-Worh merits or t caffic videe

, rme =dram swan d caw awn IL4CS4 • SKIN mammaiii Rh, IDaMp 0 Cbsaankn

Photos Taken? tall No

11030 SONTIS (dm* all It apatyl: Mani alttnikadway taralloponanascapiigkuarraisrathadran OW; klcgs Darkrglards yaaaluamlaseesfraadv_ncal Malone' ablas aed Smola an Rennet(intratact Saga SIvaas)

AECOM ANCP, Fisk(Norse Measurement Form. Van. 1.4 rev010918

AECOM Acoustics and Noise Control Practice
FIELD NOISE MEASUREMENT DATA FORM

Project Name: kk 0 a_air_b.s Project #: Date: (0-j-1 Page of
Measurement Location: cl —1 &Lite Z 4,0p P MA:N Analyst:

Sound Level Meter		Field Calibration		MeteMolooical Date
Model 4: kir		Model4: CAL- 1-00		Model #: t 3 1/2PP Tine 0bs/Meas:
Serial4: id.		Serial*: 7. e		swat 2,0533D3 W.4-
Weight A lal		Calibratior Level(dB): 114		Precipitation: Yes explain
Respon d	sl / Mel o	Pre-Test(a S		No
es	(explain)	Post-Test Q, (4 dBA		Win ady / Gusty / Calm

Topo: My /
GPS Coordinates (at SLM kXatenf
Bar Psr (He): / 4. V-1- Cloud Cover (%): I bob

Loc. ID	start Time (hh:mm)	Stop Time (hh:mm)	ifeUICS L.	L.	l....	Statistics Le	I Lso	Lso	Notes/Events
	I k ;titt								c 4,t+-
		17							Ski?

Roadway Name/Dir.			compass
Speed (postrobs,			0
Number of Lanes			
Width (pave/row)			
1- or 2- way			
Grade			
Bus Stops			
Stoplights			
Motorcycles			
Automobiles			
Medium Trucks			
Heavy Trucks			
Buses			
Count duration			

Site Doman:

als otadhab slam 4 War hen MADSI
• Staid minted by RAO 0htql Meat.. Photos Taken? Csj, No

kets Wye Veto al the orelit.dsea e opetrstscapbAsilng lemesiderlen peongtdcgs beninmilivocatdoitroeciatemantai
and tatchtts on Reverse or 'MSS Separate Shale)

AECOM ANCP, Field Noise Measurement Form, Vers. 1.4 rev010914

AECOM Acoustics and Noise Control Practice
FIELD NOISE MEASUREMENT DATA FORM

Project Name: 97 f .0 C tO,oc.'ni Project #: Date: L9,{2-172,010 Page of
Measurement Location: ,Cr— 3 Analyst: ·112.-1"

Sound Level Meter	Field Calibration	Meleorolocical Data
Model: LA T"	Model#: CA I,---16o	Model C: Ki&do Time Obs/Meas
Serial e: gIZ1	serials:	Serial If: 2,0 CR 3° 3
Weighting: A C I Flat	Calibration Level (dB): 94O17:4)	Precipitation: Yes (wedeln) I 1i;}
Response, / Fast/ her	Pre-Test +DOI MA	Wild: Steady f Gusty / Calm
Windscreen: :4(35') No (explain)	Post-Test .— 0 • b 3 dBA	Avg Wind Speed/Direction: li 31 me fr,
Topo: Flat/ Hilly	GPS Coordinates Mt SLM location)*	Temp In: g 2-- RN (h) :'S? s
Terrain: Herd/Solt / Wed IA /Snow		Bar Psr (Hg): 777,774.— Cloud Cover (%).-

Lim ID	Start Time hh:mm)	Stop Time (hh:mm)	Metrics L"	Lis	L...,	Statistics L,0	Lip	L.,,	Notes/Events
	Gra								Sttuft
	el a								L° .6i (ANL
	16139								f-10P

			compass
Roadway Name/Dir.			0
Speed (postkobsi			
Number of Lanes			
Width (paveirow)			
1- or 2- way			
Grade			
Bus Stops			
Stoplights			
Motorcycles			
Automobiles			
Medium Trucks			
Heavy Trucks			
Buses			
Count duration			

SIte Diagram:

4_4 t:::)'— • St Jam(!!' s. *ZVI 7/

01.not mamba mien lots tar Ig0nd bowl onlmild by It4IIDMIPlannwann
Additional Notes/Comments: fi,a Mobs Takeo? CY_"/ No
p4 1/44'
7 r c;lrc; IOU 0 c

Naha Sources *le ell Met appij. dart sitcntotealvey nfroall cosilanchatiogennahl leavegichlthee nbillinl°WI terlendThinil vcaleirgrinsucirtnectanicel medsonsi NOM and Skothei on Rosie ne Mated Sapient Shilel(s)

AECCM AMP: Fiekl Noise Measurement Form. Vers. 1.4 rev010918

AECOM Acoustics and Noise Control Practice

FIELD NOISE MEASUREMENT DATA FORM

Project Name: I — ck_41(, 64\1001 Project #: Date: U2-2—k. Page of

Measurement Location: Sr— Ikk. Analyst:)'")...¢"

NI ,I,e_c_vel M ter Model #: 4" SOS #: EISA C! Weigh#0 Flat 9 Fast! Isnpl Response: . / No (explain)	Field taxation mak,'fr,Circ l.-2 4(/ Serial it 11' Calibration Level (dB): 1 Pre-Test 4- 0 07 dBA Post-Test -0 ,0tt dBA	Met treat Model #: k3570 Timo Oba/Moao: Serial d: j9,5 83v5 14-1,1' Precipitation: Yes (explain) (.9 Wnd: Steady I Gusty / Calm Avg Wind Speed/Direction: 4.'
Topo: Flat/ till /Snow	GPS Coordinates Mt SLM wake?	Temp (7): g' 3, C RH (%) : ge';('
		Bar Psr (Hg): 2. 9,ra Cloud Coves

Loc. lb	Start Time (hh:mm)	Stop Time (hh:mm)	Metrics			Statistics			Notes/Events
			Lin	1,1s	Loa	l-to	loo	Lin	
	If; 13								cte r•C
	14,20								to k4 trize
	14:/4								46t'

Roadway Name/Dir.			CallpaSS
Speed (posUobs')			0
Number of Lanes			
iMdth (pave/row)			
1- Or 2- way			
Grade			
Bus Stops			
Stoplights			
		Motorcycles__	
Automobiles			
Medium Trucks			
Heavy Trucks			
Buses			
Count duration			

Site Diagram:

r -9-9c

__---)3(
ftfri

6 •reaccerdnik spitin dotter thuall034 . seed Slit 4 Ro&MmsglOaceatot Photos Taken? I Yes)

AdditionN NoteSICOMments No

A*, idell KT*

MOiCOe6)(.6 Nobs

"eg 1 2

SWIMS Kirci) all mat

&OA (at' ¯ishoonk•esNocaphirusling Imes/Mid= plofrpdcos borknotkdo to:elSolimeceJmecnantal on

AECOM ANCP. Field Noise Measurement Form, Vers. 1.4 rev01091B

AECOM Acoustics and Noise Control Practice

FIELD NOISE MEASUREMENT DATA FORM

ProjectName: ATOT i'49C Lai Erril Project #: Date: D CL, 7- I Page of

MeasurementLocation: c-T-..-g Analyst y is

Sound Level Meter		Meteoroloolcal Data
Model*: (4 Serial* 2,-o	ModelM93 O Serial A)	Model it V 3 E O Time 0bs/Meas
weightC4Fat	Cognation Level94 I 14.	Predpitation: Yes (explain) No
Ramon Slave / Fast/ Imp'	(dB): Pm-Test I-CO I dBA	WM: Steady/Gusty/Calm
Windscreen IQ/ No (explain)	Post-Test-I- 0 ,. O 1 dBA	Avg Wind SpeedeDkeedx: Z 3
Topo: Flat / Hily	GPS Coordinates fat SLM	Temp ?FE RH (%) : L>3
Terrain: Hard I Solt /Abed /Age / Snow		Bar Psr (Hg): 2_ 9,1 Cloud cover (%):

Loc. ID	Start Time (hh:mm)	Stop time (hh:mm)	Metrics L.,	L.,,	L,	Statistics Lx,	Lio	L.	Notes/Events
	1 q! c I								sissa
	n-:n1								S 1 n r'
				1					

			compass	illgLIELIM;
Roadway Name/Dir.				
Speed (post/ohs')			0	
Number of Lanes				
Width (pavekow)				
1- or 2- way				
Grade				
Bus Stops				
Stoplights				
Motorcycles				
Automobiles				
Medium Trucks				
Heavy Trucks				
Buses				
Count duration				

r • trie cumin* nib, 0 oft tem MOM. *el esnied by RarailS,WiCtoaneakn Photos Taken?Qles2)' No

rta AID /n4 Hew

80 I I

------ kcIC

Nome Sons (One WI Mapply): disinal I ltrozdway ta I opinandpperwoheav learesichithen initifO09$ toriepanide rocartna'neenehnettnnoel

Add TT D Skeen. on Reverent lodated Separate Steal

AECOM ANCP. Field Noise Measurement Form, Vers. 1.4 rev010918

AECOM Acoustics and Noise Control Practice

FIELD NOISE MEASUREMENT DATA FORM

Project Name: nor 4-9C I_A- Project #: Date: to/it/202n Page of

Measurement Location: ct- - C Analyst: k r

Model: r	Field Calbrabort	Ieorolookal Data
S/N: C2.-0)	Model: CA:). 6	Model a: K 3 6a7 Tine Obs/Meas:
Weight A C / Flat	Serial: r),7,2 C	Serial 4: i a-C bog 13;4-I
Response w Fast/ Imp!	Calibrator Level(dB): 44 419	Precipitation: Yes (explain) @C)
Windscreen . No (explain)	Pre-Test 4.0, ,iS dBA	Wind: Steady / Gusty / Calm
	Post-Test — 0 i i- dBA	Avg Wind Speed/Direction: 7, g' rws 3
Topo: Flat I Hay	@S Coordinates fat SLM location)	Temp (°F): RH
Terrain: Herd /Soft/Mixed I Agg/ Snow		Bar Psr (Hg): aCloud Cover (%):'{~a

Lot ID	Start Time (hh:mm)	Stop Time (hh:mm)	Metrics L.	L_{a}	Lifts	Statistics L_{S}	L_{40}	Le	Notes/Events
	(IV?								loud- Pi Cs u f tre.C4,5-owt
	1								VWY i owl .6 "N
					Or4·1tfrSbA				6- it ke dei t; q lt
		I t:Mil							SW f

			compass	S e Diagram:
Roadway Name/Dir.				
Speed (posUobs)			0	:11- -Q.9c ---
Number of Lanes				
Width (pavelrow)				
1- or 2- way				1+4 ran
Grade				
Bus Stops				
Stoplights				______ ...__ _____.
Motorcycles				
Automobiles				S ;c'⁷tWCdr ._._ _
Medium Trucks				
Heavy Trucks				Th.
Buses				
Count duration				

S • unicareenmum [thewteaMee

Additional Notes/Comments. S,(· WU lett PIAo C4- no a i 3 and (it Paa II) Photos Taken?(Si No

Noise SCuus Oita all NI pevgorad ata' ayte leaves:airmen riesuposss taimgresee vcalansedslehenkal

cpulandscajngusa coRowse an:Oaten Sepsis Steekst

AECOM ANCP, Fieb Noise Measurement Form, Jere. 1.4 m0109113

AECOM Acoustics and Noise Control Practice

FIELD NOISE MEASUREMENT DATA FORM

Project Name: .AiDn 49G L0r·g(05 Project #: Date: lo/LrAo2.o Page of

Measurement Location: Si'— .-' Analyser

Sound Level Meter	Freed Calibration	Meteorococat Data
Model itLat- 1	Model It C /-2-O)	Model It: k 3S c.P The Obs/Meas:
Soria tr: c).0 I	Sete ft: i	&oriel p: 2A 5 ,i• MI 3?; 21
WeIghtin C / Flat Response: Fast/ imp! Windscreen .e No (explain)	Calibration Level (0): 94 1 Post-Test ._0.4 i	Precipitation: Yes (cumlain) / Wind: Steady I Gusty / Avg Wind Speed/Direction: nvs I e
Toco: Flat/ HAy	GPS Geminates (at SLM Vocation)'	Tenn (·4 g g. 1 RN (%) : ,S?. x
Terrain: Hard / **Soft/ Mead /** Ant Snow		Bat Psr (Ho): 7 9,42_ Cloud Cover (%):

Loc. ID	Stan Time	Stop (bh:rnmi)	Matt Co	1,,,,,	1,,,,	Statistics (titcmm)	Lso	I.	Notes/Events
	n- ri c								ct CA PE
									--
		/?1,41							efiaf

Roadwav Name/Dir.			COMDDSS	site Diagram:
Speed (post/obs,			C	
Number of Lanes				
Width (pave/row)			/Er TOSEPI 1	--.
1- or 2- way				
Grade				—
Bus Stops				
Stoplights				
Motorcycles				1
Automobiles			X	c
Medium Trucks			P	
Heavy Trucks			i -VI	I
Buses			-	
Count duration				

r •rale °collies mimics/Iv lot WM •Spel aitraledby Rehr Only

tato, may he clanctir 141 ppip6r) 5 1 I (6 /.14

None Sown (Onie al Int apply): *tint Awe re opsitendacaprohnseg ienestchldien Plennegdois raven vocatinafraectienethintel

AECCM ANCP, Field Noise Measurement Form, Jars. 1.4 rev010918

AECOM Acoustics and Noise Control Practice
FIELD NOISE MEASUREMENT **DATA** FORM

Project Name: Ailpfir 4-9' Login/ Project #: Date: fit/4A Page of

Measurement Location: cm— g Analyst y ,

Model/Serial	X	Field Calibration		Meteorological Data	
a:	61,3	Model #:	I.•	Model / e3600	Time Obs/Meas
Weighting	C /Rat	Serial #:		Serial //: gas 303	i3; a 6
Response	Fast I Impl	Calibration Level (dB):	94/C)	Precipitation Yes/Wind (explain) ! No	
Windscreen	_ No (replan)	Pre-test	— 0.03 dBA	Steady/Avg/Wind / Goy / Calm	
		Post-test	— 0 , h g dBA	Speed 1 , 5	mh
Topo: Flat / Hilly		GPS Coordinates tat Sal iocationt'		Temp (T)	RN (%) : CS, •
Terrain: Hard/Soft /Mbed/Ag	/Snow			Bar Ps((Mg): I/ 3	Cloud Cover (%): ... 6

Loc. ID	Start Time (hh:mm)	Stop Time	Metrics L,,,,	L„,,	Lffu	Statistics 1,0	Li°	Leo	Notes/Events
	1 ;01								
	I :QC								6 1114441/Str) ei A kr Pr
	i3: la								PIP°

Roadway Namefar.		
Speed (post/ohs')		
Number of Lanes		
Width (pave/row)		
I. or 2- way		
Grade		
Bus Stops		
Stoplights		
Motorcycles		
Automobiles		
Medium Trucks		
Heavy Tacks		
Buses		
Count durabon		

compass 0

Site Diagram:

r- ¯496

e¯-V- -2-- 2

—

kls(COyes X

f f

Afiffs

I I

1

4

—

—

—

ri • rafecootnab system It ban Wad Additional NOles/Comments: Alp! · Speed·Imic coA)c bi at1mm/Oer Motes Taken? 41* % WEOtt I 34 I) LI ltt /No

nos Sou= (ads el the emiy) cistern eircaltiroadso to ertOrttnalcoi and i opstendsoaprotruslang leaostigOren palynordegs oarktvtatit mizinotrontohnecoinotl Skeltes K Rearm of Irdoead Separate Shags)

AEG0M ANCP, Field Noise Measurement FM. Vers. 1.4 rev010918

AECOM Acoustics and Noise Control Practice

FIELD NOISE MEASUREMENT DATA FORM

Project Name: eil pt 7 49C I, or, 514 Project #: Date: 0 '2/ Page of

Measurement Location: ,St — 9 Analysts15

Sound Level Vele(	Field CA/ration	MAIESSIE2919
Model K: L-361	Model II: Llithr-	Model it k36., o Time Obs/Meux
Serial Or C),o /	b° seat 1 2	Serial ft I.) c),>39 j? ', 55
WeightIn$ I Flat	Calibration Level (dB)94	Pmcipitalion: Yes (tap(*) (N.&
Resports Slo/ Far / Impi	14	Yrind: Steady / Gusty / Calm
Werdsaten :-Q2/ Nc (explain)	Posl-Tesl ... O tcic	Avg Weld Speed/Oirecdan: 4 ,2 fin / Pl-
Topo: flat / I lily	GPO Coordinates (at 3LM loc,ation?	Temp (T): (29, g An (%) • c..-(g
Terrain: Herd/Soft . Mixed / Ag /Snow		Ear Pu (H9): 2,9.22 Cloud Cover

Lot ID	Start Tine (hkmm)	Slop Time NIB*	Metrics 44	Lm.	Lew	Stalisks Lie	Lso	1.0	Notes/Events
	139-								3{Geire
	1 ;Or								gt,fi

Roadway Name/Dir.			cons	, r
Speed (post/cbs,			0	--
Number of Laws			n/V	z2,-v-'t--' _
Width (pave/raw)			Si. CTO-CeN	
I- or2- war				
Grade			--	--
Bus Stops				
Stoplights				
Motorcycles				\4"
Automobiles			.3	
Medium Trucks				:b.
Heavy Imola				
Buses				
Count duratbn				

qt. rat oath* Om kepi thn PAM .5med iambi by PAN/ Citift / Moab Photoe Taken? r,,.... Yes) No

fskillietttillleata Also 1n0 If erw

8e 1 0 (2 Ai b ntiii)

fussonodeatetappy,dslarlakaakatthraytra4alopsnandicaphanaliv,jatneetakistaPWAVC,JLedOSISVOCIthingfreKlalitheal
Adeeonsinwesems Steins anRoamatFacetedSepem?Samoa

AECOM ANCP, Field Wee Measurement Fan Vers. 1.4 rev010918

AECOM Acoustics and Noise Control Practice

FIELD NOISE MEASUREMENT DATA FORM

Project Name: 97⁻⁴-AG L ,1.5 Toy) Project #: Date: orb 2, i Page of

Measurement Location: 1' - Analyst: 1n-5

Sound Level Meter	Field Calibralion	Weleorolocical Data
Model #: txt	Model: CAL-Lo°	Model A: K3Coo Tme Obs/Meas:
Serial #: CIA 1	Serial #:	Serial tt: 2 a C VW i ',Z.
We Gina(	Caexation Level (dB) 91 14	Preeteakn: Yes (explain) k,_%b
R Sew est/Imp	Pre-Test o r 0 1 dBA	Wind: Steady I Gusty / Calm
Wind esNo (explain)	Post-Test ⁻,o, 0 L. dBA	Am Wind Speed/Direction;),4nvs f
Tom Flat 1 Hilly	GFS Coordinates fat SLM	Temp (*F): 7 RI1 OM : OS. 2-
Terrain: Hard / Soft / Mixed / Ap!Snow		Bar Pm (H9): Cloud Cover

Loc. ID	Start Time (hmm)	Stop Time (hmm)	Mebics L.,	t,.,	L,,,4,	&Astro L,0	to	Lt.	Notes/Events
	1 g.10								Start
	a s ,Al								steal
		iq;%6							gt' 0 P

Roadway NameiDir.			compass
Speed (post/Obs,			CD
Number of Lanes			
Width (pave/row)			
1- or 2- way			
Grade			
Bus Stops			
Stoplights			
Motorcycles			
Automobies			
Medium Trucks			
Heavy Trucks			
Buses			
Count duration			

Si e Dlagam:

. ------ ...._

- #161I OM

—— – K --

i l

Ca

- sa

: Ce

11.1t1:041418 Niel gots ta Wel Additional Notes/Comments /⁴⁴

• SF•nonsioty RiAri Omni ;Mews, Photos Taken?(,/ No

/*Ȍn b Nf t u r ! r " k i n)

Nobe Swim (Omit al MI appy): dtit sirtrafircidny aka apstaritticep'eginnlei Imesichioen prningidcgs betkosninla vocabingsandructintel AOSatal Nab and Sketches on Revegyealndkirol Separate Srteet(s)

ii

AECOM MCP, Field Noise MesaurerneM Form, Vert 1A reW10918

AECOM Acoustics and Noise Control Practice

FIELD NOISE MEASUREMENT DATA FORM

Project Name: iN\ 12 c' LA- gt L. Project a: Date: 1O/2,, Page of

Measurement Location: L..'1 - t pi it- Mei Go., C Analyst:

ond Level Meter		Field CatOration		Data	
PAodeIO.	aTC	mode:	cnif to t,	mom a. S j214,a/	Time Obs/Mees:
Senate:	10^5	Satin	It?, a—) I2-2I'	Sorter!: - 30	611-10 /0 ;;2..
Weighing: Responsr5.24.cest WndsarrejdNo / C /Flat / hp (explain)		Calibration Level (dB)	94 /ITN	Precipitation: Yes (explain) Wind: Steady / Gusty / Calm	
		Pre-Test	I 14. /- MB		
		Post-Test	) 13:9, A	Avg Wind Speeztatsctice:	2.. 3 vi
Topo: Flat / Hay		GPS Coortinates (at ELM location)·		Temp 1·9: C 2 .1	RH (%): di"
Terrain: Hard / Solt / Maed / A99 /Snow				BR Per (Hg): -7, A X/	Cloud Cowr (%), i rye) 17),

rt.

La' ID	Slag Time	Stop Time (hh:mm)	Metrics L_m	L_{ft}	L.,,	Statistics L_{10}	t:p	Li_x,	Notes/Events
	W ititiF	Oct Ib							like, SA- 4 WO
		trtt'Ct2							54-...(1- ea to ,Lt8
									in ervai 04; 0 c
									cn41/•^01t, 'she s-VII('2,1

Roadway Name/Dir.			compass	2t
speed (post/ohs"			(1)	
Number of Lanes				
Width (pave/row)				
I- or 2- way				
Grade				
Bus Stops				
Stoplights				
Motorcycles				
Automobiles				
Medium Trucks				
Heavy Tricks				
Buses				
Count duration				

_pi=drills systim ode MWS

AddiGonal Notes/Comments

• id:saw

Speed ',MS W Aim itien

Photos Taken? No

Noise Sources (dde oft dert

wry) detail elratetiostlen traffickelopillendecacinormere leareecoeldrenpleergeogs Wiringing voreelnpreedserechuntel

AECOFI1 ANCP. Field Node Measurement Form, Vers. 1.4 rev010918.

AECOM Acoustics and Noise Control Practice

FIELD NOISE MEASUREMENT DATA FORM

Project Name: Lict.j, Lori≤ tn, q Project #: Date: lb -2 k -We Page of

Measurement Location: I:I -2 Analyst: tz, r 5

nd Level Meter		Field Ca/Nation1Aeleorolocs Dab	
Model t 52,0	WOWS: (.41,2 OO	Model t. k 34-o O	Time Oes/Meas
senator: 2	Serial it	sour 2.05 gzo3	ok la In.2-
Weigh / /	Cahtialion Level (dB): ljr	Precipitation: Yes No	
Revco Flat	Pre-Test — t— dB	/ Gusty,/ Cairn	
WIndso Fast/ kV	Post-Test I d A	Avg nd SpeecYDirection: 6.3 VA) e3:	
Topo. I	GPS Coorcinales Cat SLM location?	Terry (W): 30, L.RH (.4) : 7 77m - t74	
Terrain: Hard I So Agit Snow		Bar Psr (Hg): 24.27	Cloud Cover (%): It A.

Loo ID	Start Time	lop Time (hhinm)	Meths L,	1-,,,,,	La.	Statistics I.,0	I.,0	I.,,,	Notes/Events
									1 .ic. 5iA f II : t 1
	ik•.ke	4 LID							S f A .(O p ..-.4 LT - 2
	aficetb	<-0,1							

			Compass	Ste Diagram:
RoadNay Name/Dir.			C)	
Speed (post/ohs')				
Number of Lanes				
Width (pave/row)				
1- or 2- way				
Grade				
Bus Stops				
Stoplights				
Motorcycles				
Automobiles				
Medium Trucks				
Heavy Trucks				
Buses				
Cant duration				
,..Loxsa g m. 4.0. inv taw	. Sped Ise! by Rabin:Woo/ Obiento		Photos Tacen? , I	

Additional Notes/Comments:

hose Sourcestonal:Ial Mel apply): dstvt ariatoadray Iredal op/bodscapiviusing basstihkker plapoplodogs barkiptitsvoattip/meedhieterical

Additialiel Noes and Slathes on Reveie or Indicated Separtle Sheets)

AECOM ANCP, Field Noise Measurement Form, Ven. I 4 mown!'

Equipment Calibration Certificates

Calibration Certificate

Certificate Number 2020007216

Custome •

AECOM
Saito 1200
401 West A Street
San Diego, CA 92101, limited States

Model Number **LxT1**		***Procedure Number*** **D0001.8384**	
Serial ***Number*** **0006201**		***Technician***	**Kyle Holm**
Test Results	Pass	***Calibration Date***	**29 Jun 2020**
Initial Condition **As Manufactured**		*Calibration Due*	
		Temperature	**23.64 •C t 0.25 •C**
Description	**SoundTrack LxT Class 1**	***Humidity***	**52A %RH t 2.0 %RH**
	Class 1 Sound Level Meter	***Static*** **Pressure**	**85.77 kPa t 0.13 kPa**
	Firmware Revision: 2A03		

Evaluation Method ***Tested with:*** ***Data reported in dB re 20 pPa.***

Larson Davis PRMLxT1L. S/N 069962
PCB 377802. S/N 322051
Larson Davis CAL200, S/N 9079
Larson Davis CAL291, Saki 0108

Compliance Standards **Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure 00001.8378:**

IEC 60651:2001 Type 1	**ANSI S1.4-2014 Class 1**
IEC 60804:2000 Type 1	**ANSI SIA (R2006) Type 1**
IEC 61252:2002	**ANSI S1.11 (R2009) Class 1**
IEC 81260:2001 Class 1	**ANSI S115 (R2007)**
IEC 81672:2013 Class 1	**ANSI S143 (R2007) Type I**

Issueig lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been catbrated usin measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NISI). or other national measurement institutes. and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a 1 in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This cahbrahon is a direct comparison of the unit under test to the listed reference standards and did not iwokre any sampling plans to complete. No allowance has been made for the instability of the test device due to use. time. etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertanty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard Lncertanty to express the expanded uncertainty at approximately 95% confidence level.

This report may not be reproduced, except in ful, unless permission for the publication of an approved abstract is obtained in writing from the organization issuing this report.

Correction data *cm Larson Davis LxT Manual for SoundTrack LxT *8*, SoundExpert Lxt, 1770.01 Rev *J* Supporting Firmware Version 2.301, 2015-04-30

LARSON DAVIS - A PCB PIEZOTRONICS DIV.
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

ilac-MRA ACCREDITED Ori

OD LARSON DAVIS
A PCB PIEZOTRONICS DIV.

)720-6-T14:42:51 **Page 1 of 3** D00CIS4C4RS,D

Calibration Certificate

Certificate Number 2020007219

Customer:
AECOM
Sete 1200
401 **West A Street**
San Diego, CA 92101, United States

Model Plumber LxT1		*Procedure Plumber*	**D0001.8384**
Serial *Plumber*	**0006202**	*Technician*	**Kyle Holm**
Test Results	Pass	*Calibration Date*	**29 Jun 2020**
Initial Condition **As Manufactured**		*Calibration Due*	
		Temperature	23.54 t ±0.25%
Description	**SoundTrack LxT Class 1**	*Humidity*	**52.1 %RH ± 2.0 %RH**
	Class 1 Sound Level Meter	*Static Pressure*	**85.78 kPa ± 0.13 kPa**
	Firmware Revision: 2A03		

Evaluation Method *Tested with:* *Data reported in dB re 20 pPa.*

Larson Davis PRMLxT1L. SIN 089963
PCB 377802. SRN 322055
Larson Davis CAL200, SIN 9079
Larson Davis CAL291, SIN 0108

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with **Calibration Certificate from procedure 00001.8378:**

IEC 60851:2001 Type 1	**ANSI 51.4-2014 Class 1**
IEC 60804:2000 Type 1	**ANSI 51.4 (R2006) Type 1**
IEC 61252:2002	**ANSI S1.11 (R2009) Class 1**
IEC 61280:2001 Class 1	**ANSI S1.25 (R2007)**
IEC 61672:2013 Class 1	**ANSI 51.43 (R2007) Type 1**

'suing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated usng measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST). or other national measurement institutes. and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a t in the uncertainties column **do not fall within this laboratory's scope of accrecitation.**

The quality system is registered to ISO 9001:2015.

This calbraton is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instablity of the test device due to use. time. etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Urcertanty n Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard incertanty to express the expanded uncertainty at approximately 95% confidence level.

This report may not be reproduced. except in ful. unless permission for the publication of an approved abstract is obtained in writing from the organization issuing this report.

Correction data from Larson Davis LxT Manual for SoundTrack LxT 8 SoundExpert Lxt, 1770.01 Rev J Supporting Firmware Version 2.301,2015-04-30

LARSON DAVIS - A PCB PIEZOTRONICS DIV.
1681 West 820 North
Provo, UT 84601, **United States**
716-684-0001

ODLARSON DAVIS
A PCB PIEZOTRONICS DIV.

2020-6-29T14:58:46 **Page 1 of 3** **DCP001.8406RevD**

Calibration Certificate

Certificate Number *2020007201*

Customer

AECOM
Suite 1200
401 West A Street
San Diego, CA 92101, Visited State:

Model Number LxT1
Serial ***Number*** 0005200
Test Results Pass
Initial Condition As Manufactured
Description SoundTrack LxT Class 1
Class 1 Sound Level Meter
Firmware Revision: 2A03

Procedure ***Number*** D0001.8384
Technician Kyle Holm
Calibration Date 29 Jun 202I)
Calibration Due
Temperature 23.52 •C t 025 •C
Humidity 53.3 %RH t 2.0 %RH
Static Pressure 85.72 kPa t 013 kPa

Evaluation Method ***Tested with*** ***Data reported in dB re 20 pPa.***

Larson Davis PRMLxT1L. S/N 069961
PCB 377802. S/N 322550
Larson Davis CAL200, SIN 9079
Larson Davis CAL291, S/N 0108

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure 00001.8378:

IEC 50651:2001 Type 1	ANSI 51.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI 51.4 (R2005) Type 1
IEC 61252:2002	ANSI S1.11 (R2009) Class 1
IEC 61260:2001 Class 1	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI 51.43 (R2007) Type 1

Issung lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otheiwise noted). It has been calibrated usin measurement standards traceable to the International System of Links (SI) through the National Institute of Standards and Technology (NIST). or other national measurement institutes. and meets the requirements of ISO/IEC 17025:2005.
Test points marked with a t in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2[15.

This calloration is a direct comparison of the unt under test to the listed reference standards and did not noble any sampling plans to complete. No allowance has been made for the instability of the test device due to use. time. etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertanty n Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard wiceitanty to express the expanded uncertainty at approximately 95% confidence level.

This report may not be reproduced. except in ful. unless permission for the publication of an approved abstract is obtained in writi,g from the organization issuing this report.

Correction data fran Larson Oavis LxT Manualfor SoundTrack LxT ***8.*** SoundExpert Lxt. 177001 Rev ..1Supporong Firmware Version 2.301.2015-04-30

LARSON DAVIS - A PCB PIEZOTRONICS DIV.
1681 West 820 North
Provo, UT 51601, United State:
716-684-0001

*0 1 * * .*

rAn

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

)7204-M'13:12:02 moo Page Ion DOOC:b4C4Bay

Odin Metrology, Inc.
Calibration of Sound 8 Vibration Instalments

Certificate Number 26883-3

Certificate of Calibration for
Larson Davis Calibrator

This calibration is pettarfbU by comparison **with** measurement **reference standard** microphone:

No.	
Sort No.	1315901
Calibrated IN	Mt
Cal Dine	25 MAR 2020
Due Dab	25 MAR 2021

a) Estimated uncertainty of comparison: * 0.06 dB
b) Estimated uncertainty of calibration service for standard pistonpfsone:* 0.08 dB
s) Total oricerlimir. re ii k 0.08 dB
d) Expanded uncertainty (coverage factor k • 2 for 95% conAdence IMMO: • 2 0.15 dB

This acoustic calibrator has been calibrated using standards with values traceable to the National Institute of Standards and Technology. This calibration is traceable to NIST Test Number **683/289533.17.**

CONDITION Of TEST		
Ambient Pressure	**989.21**	**hPa**
Temperature	23	'C
Relative Humidity	**42**	**%**
Date of Calibration	**11 OCT 2020**	
Re-calibration due on	**11 OCT 2021**	

The calibration of this acoustic calibrator was performed using a test system conforming to the requirements of ANSVNCSLZ540-1, **1994, ISO** 17025, and ISO 9001:2015, Certification NQA No. 11252.

Calibration procedure: **PAP-1001-Acousfic_Caltalor, Rev. 1.020130622**

Calibration performed **by *4.44._A***

Harold Lynch, Service Manager

Calibrator type	**CALM('**
Serial no.	**3704**
Submitted by	**AECOM** **San Diego, CA 92101**
Purchase order no.	**Credit Card**
Asset no.	**N/A**

This calibrator has been found to perform within the specifications listed below at the normalized conditions stated.

SPL produced in coupler terminated by a loading	**94.0 ± 0.2 dB** **114 t 0.2 dB**
Frequency	**1 000 Hzt 1%**
Distortion	**< 2 %**

At 1,013 hPa, 23'C and 65% relative humidity

PERFORMANCE AS RECEIVED		
Frequency	**1000.3**	**Hz**
SPL (94 **dB)**	**93.97**	**dB**
SPL (114 dB)	**113.97**	**dB**
Distortion (at 94 **dB)**	**0.3**	**%**
Battery Voltage	**9.4**	**V**

Was adjustment performed? **No**
Were batteries replaced? No

FINAL PERFORMANCE		
Frequency	1(	Hz
SPL (94 dB)	**93.97**	dB
SPL (114 dB)	**113.97**	dB
Distortion (at 94 dB)	**0.3**	%

Note: This calibrator was **within manufacturers** specifications as received.

ODIN METROLOGY, INC.
3533 OLD CONEJO ROAD, SUITE 125
THOUSAND OAKS, CA 91320
PHONE: (805) 375-0830; FAx: (805) 375-0405

Appendix B: Sample TNM Input/Output Files

Sample TNM output tables are provided for CNE 1 Abatement analysis. Additional input and output files are available upon request.

CNE 1 TNM Sound Level Prediction Output Table

Sound Levels : Abt1d-0811:3

AECOM
Andrew Schad

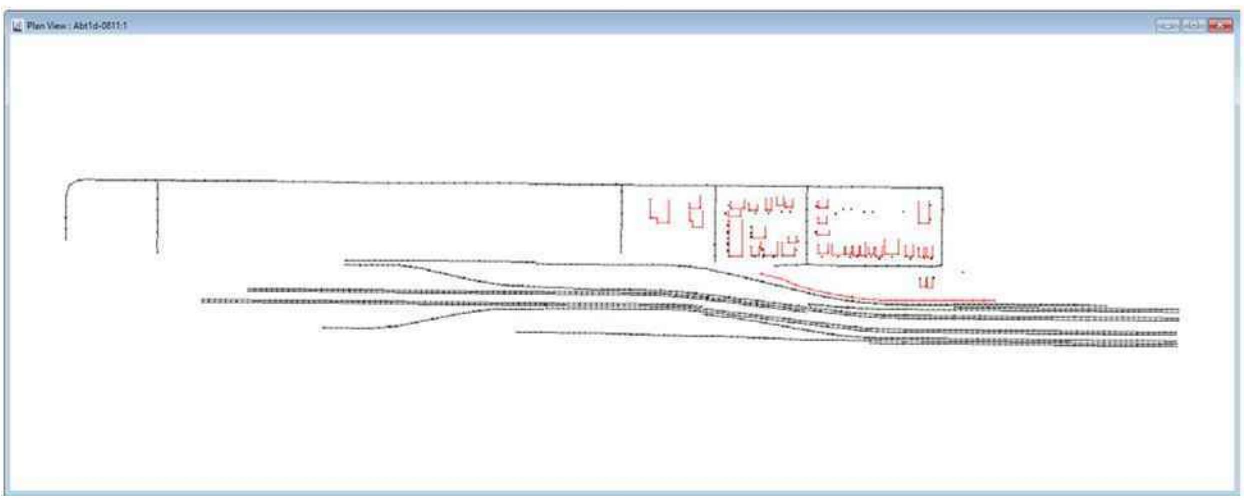
18 August 2021
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: I-496 Lansing
RUN: CNE 1 Abatement
BARRIER DESIGN: YZS 1d
ATMOSPHERICS: 68 deg F, 50% RH

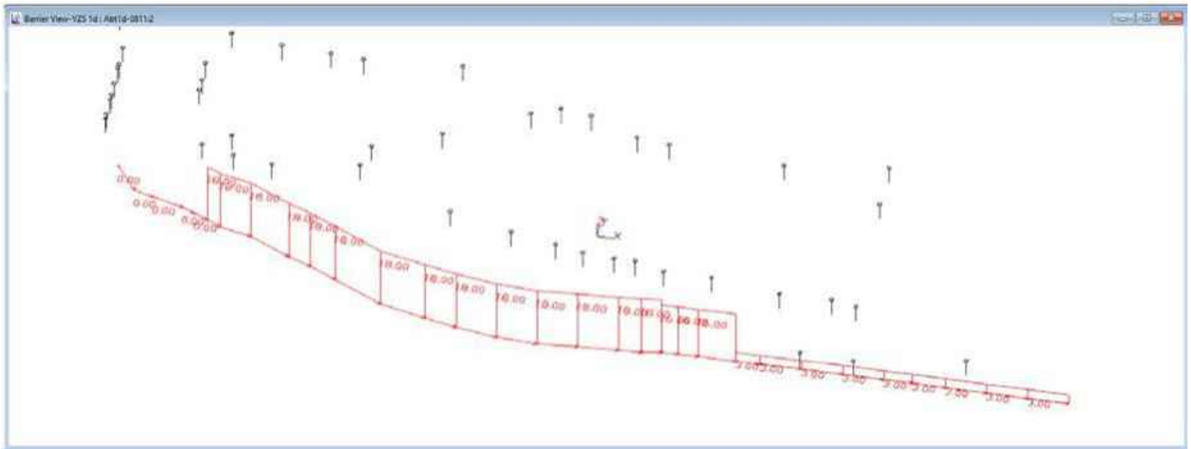
Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver												
Name	No.	#DUs	Existing	No Barrier					With Barrier			
			LAeq1h	LAeq1h		Increase over existing		Type	Calculated	Noise Reduction		
				Calculated	Crit'n	Calculated	Crit'n Sub'l Inc	Impact	LAeq1h	Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
01-01	1	1	0.0	65.6	66	65.6	10	—	65.6	0.0	8	-8.0
01-02	2	1	0.0	65.1	66	65.1	10	—	65.1	0.0	8	-8.0
01-03	3	1	0.0	63.7	66	63.7	10	—	63.7	0.0	8	-8.0
01-04	4	1	0.0	63.3	66	63.3	10	—	63.3	0.0	8	-8.0
01-05	6	1	0.0	62.3	66	62.3	10	—	62.3	0.0	8	-8.0
01-06	7	1	0.0	61.3	66	61.3	10	—	61.2	0.1	8	-7.9
01-07	8	1	0.0	60.9	66	60.9	10	—	60.9	0.0	8	-8.0
01-08	9	1	0.0	60.0	66	60.0	10	—	60.0	0.0	8	-8.0
01-09	10	1	0.0	57.9	66	57.9	10	—	57.9	0.0	8	-8.0
01-10	11	1	0.0	56.2	66	56.2	10	—	56.2	0.0	8	-8.0
01-11	12	1	0.0	69.8	66	69.8	10	Snd Lvl	67.2	2.6	8	-5.4
01-12	13	1	0.0	60.6	66	60.6	10	—	57.9	2.7	8	-5.3
01-13	14	1	0.0	69.6	66	69.6	10	Snd Lvl	65.8	3.8	8	-4.2
01-14	15	1	0.0	69.7	66	69.7	10	Snd Lvl	64.4	5.3	8	-2.7
01-15	16	1	0.0	56.9	66	56.9	10	—	56.4	0.5	8	-7.5
01-16	17	1	0.0	55.3	66	55.3	10	—	55.1	0.2	8	-7.8
01-17	18	1	0.0	53.6	66	53.6	10	—	53.5	0.1	8	-7.9
01-18	19	1	0.0	68.3	66	68.3	10	Snd Lvl	61.0	7.3	8	-0.7

Plan View



Barrier Analysis Screenshot



Barrier Description Table

Barrier Descriptions Table : Abt1d-0811:3

AECOM				18 August 2021							
Andrew Schad				TNM 2.5							
RESULTS: BARRIER DESCRIPTIONS											
PROJECT/CONTRACT:	I-496 Lanssing										
RUN:	CNE 1 Abatement										
BARRIER DESIGN:	YZS 1d										
Barriers											
Name	Type	Heights along Barrier			Length	If Wall	If Berm				Cost
		Min	Avg	Max		Area	Volume	Top Width	Run:Rise		
		ft	ft	ft	ft	sq ft	cu yd	ft	ft:ft		$
Barrier371	W	3.00	3.00	3.00	405	1215					0
Barrier369	W	16.00	17.73	18.00	677	12014					0
									Total Cost:		0

Appendix C: Predicted Noise Levels and Impacts

Table C-1 Loudest Hour Noise Levels, Leq(1h), dBA

Receptor Number	Land Use	Activity Category	Units	FHWA/MDOT NAC	Existing	Build	Change
CNE 1							
01-01	Residential	B	1	67	65	**66**	+1
01-02	Residential	B	1	67	65	65	+1
01-03	Residential	B	1	67	63	64	+1
01-04	Residential	B	1	67	63	63	+1
01-05	Residential	B	1	67	62	62	+1
01-06	Residential	B	1	67	61	61	+1
01-07	Residential	B	1	67	60	61	+1
01-08	Residential	B	1	67	59	60	+1
01-09	Residential	B	1	67	57	58	+1
01-10	Residential	B	1	67	56	56	+1
01-12	Residential	B	1	67	60	**70**	+1
01-13	Residential	B	1	67	**69**	61	+1
01-14	Residential	B	1	67	**69**	**70**	+1
01-15	Residential	B	1	67	56	**70**	+1
01-16	Residential	B	1	67	55	57	+1
01-17	Residential	B	1	67	53	55	+1
01-18	Residential	B	1	67	**67**	54	+1
01-19	Residential	B	1	67	64	**68**	+2
01-20	Residential	B	1	67	55	**66**	+1
01-21	Residential	B	1	67	56	56	+1
01-22	Residential	B	1	67	59	57	+1
01-23	Residential	B	1	67	59	61	+1
01-24	Residential	B	1	67	**69**	60	+1
01-25	Residential	B	1	67	**68**	**70**	+1
01-26	Residential	B	1	67	**66**	**68**	+1
01-27	Residential	B	1	67	66	**67**	+1
01-28	Residential	B	1	67	65	**66**	+1
01-29	Residential	B	1	67	65	**66**	+1
01-30	Residential	B	1	67	65	**66**	+1
01-31	Residential	B	1	67	65	65	+1
01-32	Residential	B	1	67	66	65	+1
01-33	Residential	B	1	67	**66**	65	+1
01-34	Residential	B	1	67	**67**	65	+1
01-35	Residential	B	1	67	59	65	+1
01-36	Residential	B	1	67	56	60	+1
01-37	Residential	B	1	67	57	57	+1
01-38	Residential	B	1	67	58	58	+1
01-39	Residential	B	1	67	58	59	+1
01-40	Residential	B	1	67	58	59	+1
01-41	Residential	B	1	67	58	59	+1
01-42	Residential	B	1	67	59	59	+1
01-43	Residential	B	1	67	62	59	+1
01-44	Residential	B	1	67	63	62	+1
01-45	Park	C	1	67	**71**	63	+1
01-46	Residential	B	1	67	64	64	+1
01-47	Residential	B	1	67	60	60	+1
CNE 2							
02-01	Residential	B	1	67	62	62	+1
02-02	Residential	B	1	67	58	58	+1
02-03	Residential	B	1	67	55	56	+1
02-04	Residential	B	1	67	54	54	+1
02-05	Residential	B	1	67	**67**	**68**	+1
02-06	Residential	B	1	67	63	64	+1

Receptor Number	Land Use	Activity Category	Units	FHWA/MDOT NAC	Existing	Build	Change
02-07	Residential	B	1	67	60	60	+1
02-08	Residential	B	1	67	62	63	+1
02-09	Residential	B	1	67	59	60	+1
02-10	Residential	B	1	67	63	64	+1
02-12	Residential	B	1	67	63	64	+1
02-13	Residential	B	1	67	65	**66**	+1
02-14	Residential	B	1	67	65	**66**	+1
02-15	Park	C	1	67	**67**	**68**	+1
02-16	Residential	B	1	67	62	63	+1
CNE 3							
03-01	Residential	B	1	67	62	62	+0
03-02	Residential	B	1	67	57	57	+1
03-03	Residential	B	1	67	60	61	+1
03-04	Residential	B	1	67	**66**	**66**	+0
03-05	Residential	B	1	67	47	48	+1
03-06	Residential	B	1	67	54	54	+1
CNE 4							
04-01	Park	C	1	67	**67**	**68**	+0
04-02	Park	C	1	67	**67**	**67**	+0
04-03	Park	C	1	67	61	61	+0
04-04	Park	C	1	67	57	57	+1
04-05	Park	C	1	67	57	57	+1
04-06	Park	C	1	67	56	56	+1
04-07	Park	C	1	67	55	56	+1
CNE 5							
05-01	Residential	B	1	67	**69**	**70**	+1
05-02	Residential	B	1	67	**69**	**70**	+1
05-03	Residential	B	1	67	**69**	**70**	+0
05-04	Residential	B	1	67	**69**	**69**	+1
05-05	Residential	B	1	67	**69**	**69**	+0
05-06	Residential	B	1	67	61	62	+0
05-07	Residential	B	1	67	58	58	+1
05-08	Residential	B	1	67	53	53	+0
05-09	Residential	B	1	67	51	51	+1
05-10	Residential	B	1	67	55	55	+1
05-11	Residential	B	1	67	54	54	+0
05-12	Residential	B	1	67	53	53	+0
05-13	Residential	B	1	67	55	55	+1
05-14	Residential	B	1	67	54	54	+0
05-15	Residential	B	1	67	56	56	-0
CNE 6							
06-01	Residential	B	1	67	**68**	**68**	-0
06-02	Residential	B	1	67	63	62	-0
06-03	Residential	B	1	67	58	58	0
06-04	Residential	B	1	67	58	58	+0
06-05	Residential	B	1	67	58	58	+0
06-06	Residential	B	1	67	59	59	+0
06-07	Residential	B	1	67	59	59	+0
06-08	Residential	B	1	67	61	61	+0
06-09	Residential	B	1	67	55	55	+0
06-10	Residential	B	1	67	55	55	+0
06-11	Residential	B	1	67	50	50	+0
06-12	Residential	B	1	67	49	49	+0
06-13	Residential	B	1	67	49	49	+0
06-14	Park	C	1	67	51	51	+0
06-101	Residential	B	1	67	63	64	+0
06-102	Residential	B	1	67	63	63	+0
06-103	Residential	B	1	67	59	59	+0
06-104	Residential	B	1	67	60	61	+0
06-105	Residential	B	1	67	59	59	+0

Receptor Number	Land Use	Activity Category	Units	FHWA/MDOT NAC	Existing	Build	Change
06-106	Residential	B	1	67	61	62	+0
06-107	Residential	B	1	67	62	62	0
06-108	Residential	B	1	67	65	65	+1
06-109	Residential	B	1	67	51	51	+0
06-110	Residential	B	1	67	51	51	+0
06-111	Residential	B	1	67	51	52	+0
06-112	Residential	B	1	67	51	51	+0
06-113	Residential	B	1	67	51	51	+0
06-114	Residential	B	1	67	51	51	+0
06-115	Residential	B	1	67	56	55	-0
06-116	Residential	B	1	67	60	60	+0
06-117	Residential	B	1	67	54	54	+0
06-118	Residential	B	1	67	59	59	+0
06-119	Residential	B	1	67	63	63	+0
06-120	Residential	B	1	67	**67**	**67**	+0
06-121	Residential	B	1	67	65	65	0
06-122	Residential	B	1	67	61	62	+0
06-123	Residential	B	1	67	54	55	+0
06-124	Residential	B	1	67	56	57	+0
06-125	Residential	B	1	67	52	52	+0
06-126	Residential	B	1	67	52	52	+0
06-127	Residential	B	1	67	54	54	+0
06-128	Residential	B	1	67	50	50	+0
06-129	Residential	B	1	67	59	59	+0
06-130	Residential	B	1	67	60	60	+0
06-131	Residential	B	1	67	48	48	+0
06-132	Residential	B	1	67	48	48	+0
06-133	Residential	B	1	67	48	48	+0
06-134	Residential	B	1	67	47	47	+0
06-201	Residential	B	1	67	**68**	**68**	+0
06-202	Residential	B	1	67	**68**	**68**	+0
06-203	Residential	B	1	67	64	64	+0
06-204	Residential	B	1	67	65	65	+0
06-205	Residential	B	1	67	64	64	+0
06-206	Residential	B	1	67	**67**	**67**	+1
06-207	Residential	B	1	67	**68**	**68**	+1
06-208	Residential	B	1	67	**71**	**71**	+0
06-209	Residential	B	1	67	53	53	+0
06-210	Residential	B	1	67	53	53	+0
06-211	Residential	B	1	67	53	53	+0
06-212	Residential	B	1	67	52	52	+0
06-213	Residential	B	1	67	51	51	+0
06-214	Residential	B	1	67	51	51	+0
06-215	Residential	B	1	67	62	62	0
06-216	Residential	B	1	67	**66**	**67**	+1
06-217	Residential	B	1	67	61	61	+0
06-218	Residential	B	1	67	**66**	**66**	+1
06-219	Residential	B	1	67	**70**	**70**	+0
06-220	Residential	B	1	67	**72**	**72**	+0
06-221	Residential	B	1	67	**70**	**71**	+0
06-222	Residential	B	1	67	**67**	**68**	+0
06-223	Residential	B	1	67	58	59	+0
06-224	Residential	B	1	67	61	61	+0
06-225	Residential	B	1	67	54	54	+0
06-226	Residential	B	1	67	55	55	+0
06-227	Residential	B	1	67	58	58	+0
06-228	Residential	B	1	67	55	55	-0
06-229	Residential	B	1	67	64	64	+0
06-230	Residential	B	1	67	65	65	+0
06-231	Residential	B	1	67	49	50	+0

Receptor Number	Land Use	Activity Category	Units	FHWA/MDOT NAC	Existing	Build	Change
06-232	Residential	B	1	67	48	49	+0
06-233	Residential	B	1	67	47	48	+0
06-234	Residential	B	1	67	48	49	+0
06-301	Residential	B	1	67	**71**	**71**	+0
06-302	Residential	B	1	67	**71**	**71**	+0
06-303	Residential	B	1	67	**67**	**68**	+1
06-304	Residential	B	1	67	**68**	**69**	+1
06-305	Residential	B	1	67	**67**	**68**	+1
06-306	Residential	B	1	67	**70**	**70**	+0
06-307	Residential	B	1	67	**70**	**70**	+0
06-308	Residential	B	1	67	**71**	**71**	+0
06-309	Residential	B	1	67	58	58	+0
06-310	Residential	B	1	67	57	57	+0
06-311	Residential	B	1	67	57	57	+0
06-312	Residential	B	1	67	56	56	+0
06-313	Residential	B	1	67	55	55	+0
06-314	Residential	B	1	67	55	55	+0
06-315	Residential	B	1	67	65	65	+0
06-316	Residential	B	1	67	**68**	**68**	+0
06-317	Residential	B	1	67	64	64	+0
06-318	Residential	B	1	67	**68**	**68**	+0
06-319	Residential	B	1	67	**70**	**70**	+0
06-320	Residential	B	1	67	**72**	**72**	+0
06-321	Residential	B	1	67	**71**	**72**	+0
06-322	Residential	B	1	67	**70**	**70**	+1
06-323	Residential	B	1	67	61	62	+0
06-324	Residential	B	1	67	64	64	+0
06-325	Residential	B	1	67	57	57	+0
06-326	Residential	B	1	67	59	59	+0
06-327	Residential	B	1	67	61	61	+0
06-328	Residential	B	1	67	59	59	+0
06-329	Residential	B	1	67	**67**	**68**	+0
06-330	Residential	B	1	67	**68**	**68**	+0
06-331	Residential	B	1	67	52	52	+0
06-332	Residential	B	1	67	51	51	+0
06-333	Residential	B	1	67	52	52	+0
06-334	Residential	B	1	67	52	52	+0
CNE 7							
07-01	Residential	B	1	67	**68**	**69**	+1
07-02	Residential	B	1	67	**69**	**70**	+1
07-03	Residential	B	1	67	**69**	**70**	+1
07-04	Residential	B	1	67	**69**	**70**	+1
07-05	Residential	B	1	67	**69**	**70**	+1
07-06	Residential	B	1	67	**69**	**70**	+1
07-07	Residential	B	1	67	**69**	**70**	+1
07-08	Residential	B	1	67	**70**	**71**	+1
07-09	Residential	B	1	67	**69**	**70**	+1
07-10	Residential	B	1	67	**69**	**70**	+1
07-11	Residential	B	1	67	**69**	**70**	+2
07-12	Residential	B	1	67	**69**	**71**	+1
07-13	Residential	B	1	67	**70**	**71**	+1
07-14	Residential	B	1	67	**69**	**70**	+1
07-15	Residential	B	1	67	**69**	**71**	+1
07-16	Residential	B	1	67	**70**	**71**	+1
07-17	Residential	B	1	67	**70**	**71**	+1
07-18	Residential	B	1	67	**71**	**72**	+1
07-19	Residential	B	1	67	**69**	**70**	+1
07-20	Residential	B	1	67	**71**	**72**	+1
07-21	Residential	B	1	67	**72**	**72**	+1
07-22	Residential	B	1	67	**72**	**72**	+0

Receptor Number	Land Use	Activity Category	Units	FHWA/MDOT NAC	Existing	Build	Change
07-23	Residential	B	1	67	**72**	**72**	+0
07-24	Residential	B	1	67	**72**	**72**	+1
07-25	Residential	B	1	67	**72**	**72**	+0
07-26	Residential	B	1	67	**71**	**72**	+1
07-27	Residential	B	1	67	**71**	**71**	+1
07-28	Residential	B	1	67	**72**	**72**	+1
07-29	Residential	B	1	67	**72**	**72**	+1
07-30	Residential	B	1	67	**72**	**72**	+1
07-31	Residential	B	1	67	**72**	**73**	+1
07-32	Residential	B	1	67	**72**	**73**	+1
07-33	Residential	B	1	67	**74**	**74**	+1
07-34	Residential	B	1	67	62	62	+0
07-35	Residential	B	1	67	58	58	+0
07-36	Residential	B	1	67	52	52	+1
07-37	Residential	B	1	67	60	61	+1
07-38	Residential	B	1	67	57	58	+1
07-39	Residential	B	1	67	59	61	+1
07-40	Residential	B	1	67	60	60	+1
07-41	Residential	B	1	67	56	57	+1
07-42	Residential	B	1	67	54	54	+1
07-43	Residential	B	1	67	58	59	+1
07-44	Residential	B	1	67	54	55	+1
07-45	Residential	B	1	67	**69**	**69**	+0
07-46	Residential	B	1	67	**68**	**68**	+1
07-47	Residential	B	1	67	54	54	+1
07-48	Residential	B	1	67	52	52	+1
07-49	Residential	B	1	67	50	51	+1
07-50	Residential	B	1	67	53	53	+0
07-51	Residential	B	1	67	55	55	+0
07-52	Residential	B	1	67	51	52	+0
07-53	Residential	B	1	67	58	59	+0
07-54	Residential	B	1	67	49	49	+0
07-55	Residential	B	1	67	49	50	+0
07-56	Residential	B	1	67	52	53	+1
07-57	Residential	B	1	67	48	49	+0
07-58	Residential	B	1	67	51	51	+1
07-59	Residential	B	1	67	51	51	+0
07-60	Residential	B	1	67	50	50	+0
07-61	Residential	B	1	67	52	53	+1
07-62	Residential	B	1	67	55	55	+0
07-63	Residential	B	1	67	60	60	+0
07-64	Residential	B	1	67	61	61	+1
07-65	Residential	B	1	67	61	62	+0
07-66	Residential	B	1	67	64	64	+0
CNE 8							
08-01	Residential	B	1	67	**68**	**69**	+1
08-02	School	C	1	67	**67**	**68**	+1
08-03	Residential	B	1	67	**69**	**70**	+1
08-04	Residential	B	1	67	**72**	**72**	0
08-05	Residential	B	1	67	**71**	**71**	+0
08-06	Residential	B	1	67	**71**	**71**	+0
08-07	Residential	B	1	67	**71**	**71**	0
08-08	Residential	B	1	67	**71**	**71**	+0
08-09	Residential	B	1	67	**70**	**71**	+0
08-10	Residential	B	1	67	**71**	**71**	+0
08-11	Residential	B	1	67	**71**	**71**	+0
08-12	Residential	B	1	67	**71**	**71**	-0
08-13	Residential	B	1	67	**72**	**71**	-1
08-14	Residential	B	1	67	**72**	**71**	-1
08-15	Residential	B	1	67	**71**	**71**	-1

Receptor Number	Land Use	Activity Category	Units	FHWA/MDOT NAC	Existing	Build	Change
08-16	Residential	B	1	67	**72**	**71**	-1
08-17	Residential	B	1	67	59	60	+1
08-18	Residential	B	1	67	54	55	+0
08-19	Residential	B	1	67	53	53	+0
08-20	Residential	B	1	67	52	53	+1
08-21	Residential	B	1	67	56	57	+1
08-22	Residential	B	1	67	52	52	+1
08-23	School	C	1	67	53	53	+1
08-24	School	C	1	67	53	53	+0
08-25	School	C	1	67	53	54	+0
08-26	Church	C	1	67	59	60	+1
08-27	Residential	B	1	67	54	54	+0
08-28	Residential	B	1	67	60	60	0
08-29	Residential	B	1	67	56	56	-0
08-30	Residential	B	1	67	54	54	+0
08-31	Residential	B	1	67	52	52	0
08-32	Residential	B	1	67	51	51	0
08-33	Residential	B	1	67	61	61	-0
08-34	Residential	B	1	67	59	59	-0
08-35	Residential	B	1	67	56	56	-0
08-36	Residential	B	1	67	54	54	-0
08-37	Residential	B	1	67	53	53	+0
08-38	Residential	B	1	67	61	61	0
08-39	Residential	B	1	67	57	57	0
08-40	Residential	B	1	67	55	55	+0
08-41	Residential	B	1	67	54	54	+0
08-42	Residential	B	1	67	53	54	+0
08-43	Residential	B	1	67	62	62	-0
08-44	Residential	B	1	67	57	57	0
08-45	Residential	B	1	67	55	55	+0
08-46	Residential	B	1	67	62	62	+0
08-47	Residential	B	1	67	60	60	+0
08-48	Residential	B	1	67	60	60	+0
08-49	Residential	B	1	67	58	59	+0
08-50	Residential	B	1	67	58	58	+0
08-51	Residential	B	1	67	54	54	+0
08-52	Residential	B	1	67	52	52	+0
08-53	Residential	B	1	67	49	49	+0
08-54	Residential	B	1	67	49	49	+0
08-55	Residential	B	1	67	52	52	+0
08-56	Residential	B	1	67	49	50	+0
CNE 9							
09-01	Park	C	1	67	**66**	**66**	-0
09-02	School	C	1	67	**68**	**68**	0
09-03	School	C	1	67	65	65	0
09-04	Residential	B	1	67	63	63	-0
09-05	Residential	B	1	67	**68**	**67**	-0
09-06	Residential	B	1	67	**68**	**68**	-0
09-07	Residential	B	1	67	**68**	**68**	0
09-08	Residential	B	1	67	**68**	**68**	+0
09-09	Residential	B	1	67	**68**	**68**	+0
09-10	Residential	B	1	67	**68**	**68**	+0
09-11	Residential	B	1	67	**68**	**68**	+0
09-12	Residential	B	1	67	58	58	0
09-13	Residential	B	1	67	54	54	0
09-14	Residential	B	1	67	53	53	+0
09-15	Residential	B	1	67	53	53	+0
09-16	Residential	B	1	67	53	53	+0
09-17	Residential	B	1	67	54	54	+0
09-18	Residential	B	1	67	53	53	+0

Receptor Number	Land Use	Activity Category	Units	FHWA/MDOT NAC	Existing	Build	Change
09-19	Residential	B	1	67	51	51	+0
09-20	Residential	B	1	67	49	49	+0
09-21	Residential	B	1	67	52	52	+0
09-22	Residential	B	1	67	52	52	+0
09-23	Residential	B	1	67	53	53	+0
09-24	Residential	B	1	67	53	54	+0
09-25	Residential	B	1	67	51	51	+0
09-26	Residential	B	1	67	52	52	+0
CNE-10							
10-01	Residential	B	1	67	**67**	**67**	+0
10-02	Residential	B	1	67	**67**	**67**	+0
10-03	Residential	B	1	67	**67**	**67**	+0
10-04	Residential	B	1	67	**68**	**68**	+0
10-05	Residential	B	1	67	**67**	**67**	+0
10-06	Residential	B	1	67	**66**	**66**	+0
10-07	Residential	B	1	67	**68**	**68**	+0
10-08	Residential	B	1	67	**67**	**67**	+0
10-09	Residential	B	1	67	**68**	**68**	+0
10-10	Residential	B	1	67	**68**	**68**	+0
10-11	Residential	B	1	67	59	59	+0
10-12	Residential	B	1	67	55	55	+0
10-13	Residential	B	1	67	53	54	+0
10-14	Residential	B	1	67	60	61	+0
10-15	Residential	B	1	67	56	57	+0
10-16	Residential	B	1	67	54	54	+0
10-17	Residential	B	1	67	54	54	+0
10-18	Residential	B	1	67	49	49	+0
10-19	Residential	B	1	67	49	50	+0
10-20	Residential	B	1	67	59	60	+0
10-21	Residential	B	1	67	56	57	+1
10-22	Residential	B	1	67	53	54	+1
10-23	Residential	B	1	67	48	49	+0
10-24	Residential	B	1	67	48	48	+0

Appendix D: Noise Barrier Analysis Detail

Table D-1 Existing and Predicted Future Build Noise Levels and Barrier Analysis

Receptor Number	Land Use	Category	Units	FHWA/MDOT NAC	Build	Noise Level w/Barr	Noise Reduction	Benefit?
Wall 1								
01-01	Residential	B	1	67	66	66	0	
01-02	Residential	B	1	67	65	65	0	
01-03	Residential	B	1	67	64	64	0	
01-04	Residential	B	1	67	63	63	0	
01-05	Residential	B	1	67	62	62	0	
01-06	Residential	B	1	67	61	61	0	
01-07	Residential	B	1	67	61	61	0	
01-08	Residential	B	1	67	60	60	0	
01-09	Residential	B	1	67	58	58	0	
01-10	Residential	B	1	67	56	56	0	
01-12	Residential	B	1	67	61	58	3	
01-13	Residential	B	1	67	70	66	4	
01-14	Residential	B	1	67	70	64	5	Y
01-15	Residential	B	1	67	57	56	1	
01-16	Residential	B	1	67	55	55	0	
01-17	Residential	B	1	67	54	54	0	
01-18	Residential	B	1	67	68	61	7	Y
01-19	Residential	B	1	67	66	56	10	Y
01-20	Residential	B	1	67	56	55	1	
01-21	Residential	B	1	67	57	56	2	
01-22	Residential	B	1	67	61	57	3	
01-23	Residential	B	1	67	60	54	6	Y
01-24	Residential	B	1	67	70	62	8	Y
01-25	Residential	B	1	67	68	61	8	Y
01-26	Residential	B	1	67	67	61	7	Y
01-27	Residential	B	1	67	66	61	6	Y
01-28	Residential	B	1	67	66	61	5	Y
01-29	Residential	B	1	67	66	61	5	Y
01-30	Residential	B	1	67	65	61	4	
01-31	Residential	B	1	67	65	62	3	
01-32	Residential	B	1	67	65	63	2	
01-33	Residential	B	1	67	65	64	1	
01-34	Residential	B	1	67	65	65	1	
01-35	Residential	B	1	67	60	53	7	Y
01-36	Residential	B	1	67	57	53	4	
01-37	Residential	B	1	67	58	56	3	
01-38	Residential	B	1	67	59	57	2	
01-39	Residential	B	1	67	59	57	2	
01-40	Residential	B	1	67	59	57	2	
01-41	Residential	B	1	67	59	58	2	
01-42	Residential	B	1	67	59	57	2	
01-43	Residential	B	1	67	62	62	0	
01-44	Residential	B	1	67	63	63	0	
01-45	Park	C	1	67	68	68	0	
01-46	Residential	B	1	67	64	64		

Receptor Number	Land Use	Category	Units	FHWA/MDOT NAC	Build	Noise Level w/Barr	Noise Reduction	Benefit?
01-47	Residential	B	1	67	60	60	0	
Wall 2								
02-01	Residential	B	1	67	62	61	1	
02-02	Residential	B	1	67	58	58	1	
02-03	Residential	B	1	67	56	56	0	
02-04	Residential	B	1	67	54	54	0	
02-05	Residential	B	1	67	68	63	4	
02-06	Residential	B	1	67	64	59	5	Y
02-07	Residential	B	1	67	60	56	5	Y
02-08	Residential	B	1	67	63	58	5	Y
02-09	Residential	B	1	67	60	60	0	
02-10	Residential	B	1	67	64	64	0	
02-12	Residential	B	1	67	64	64	0	
02-13	Residential	B	1	67	66	66	0	
02-14	Residential	B	1	67	66	66	0	
02-15	Park	C	1	67	68	68	0	
02-16	Park	C	1	67	63	63	0	
Wall 4								
04-01	Park	C	1	67	68	64	3	
04-02	Park	C	1	67	67	64	4	
04-03	Park	C	1	67	61	58	3	
04-04	Park	C	1	67	57	56	2	
04-05	Park	C	1	67	57	56	1	
04-06	Park	C	1	67	56	55	1	
04-07	Park	C	1	67	56	55	1	
Wall 5								
05-01	Residential	B	1	67	70	69	1	
05-02	Residential	B	1	67	70	68	2	
05-03	Residential	B	1	67	70	68	2	
05-04	Residential	B	1	67	69	67	2	
05-05	Residential	B	1	67	69	67	2	
05-06	Residential	B	1	67	62	59	3	
05-07	Residential	B	1	67	58	56	2	
05-08	Residential	B	1	67	53	53	0	
05-09	Residential	B	1	67	51	50	1	
05-10	Residential	B	1	67	55	54	1	
05-11	Residential	B	1	67	54	53	1	
05-12	Residential	B	1	67	53	52	1	
05-13	Residential	B	1	67	55	54	1	
05-14	Residential	B	1	67	54	53	1	
05-15	Residential	B	1	67	56	56	0	
05-01	Residential	B	1	67	70	69	1	
05-02	Residential	B	1	67	70	68	2	
05-03	Residential	B	1	67	70	68	2	
05-04	Residential	B	1	67	69	67	2	
Wall 6								

Receptor Number	Land Use	Category	Units	FHWA/MDOT NAC	Build	Noise Level w/Barr	Noise Reduction	Benefit?
06-02	Residential	B	1	67	62	62	0	
06-03	Residential	B	1	67	58	58	0	
06-04	Residential	B	1	67	58	58	0	
06-05	Residential	B	1	67	58	57	0	
06-06	Residential	B	1	67	59	59	0	
06-07	Residential	B	1	67	59	59	1	
06-08	Residential	B	1	67	61	61	1	
06-09	Residential	B	1	67	55	55	0	
06-10	Residential	B	1	67	55	55	0	
06-101	Residential	B	1	67	64	63	1	
06-102	Residential	B	1	67	63	62	1	
06-103	Residential	B	1	67	59	57	2	
06-104	Residential	B	1	67	61	60	1	
06-105	Residential	B	1	67	59	59	1	
06-106	Residential	B	1	67	62	61	1	
06-107	Residential	B	1	67	62	61	1	
06-108	Residential	B	1	67	65	62	3	
06-115	Residential	B	1	67	55	51	5	Y
06-116	Residential	B	1	67	60	54	6	Y
06-118	Residential	B	1	67	59	54	5	Y
06-119	Residential	B	1	67	63	60	3	
06-120	Residential	B	1	67	67	62	5	Y
06-121	Residential	B	1	67	65	61	4	
06-122	Residential	B	1	67	62	59	3	
06-123	Residential	B	1	67	55	54	0	
06-124	Residential	B	1	67	57	55	2	
06-129	Residential	B	1	67	59	57	2	
06-130	Residential	B	1	67	60	57	3	
06-201	Residential	B	1	67	68	66	2	
06-202	Residential	B	1	67	68	66	2	
06-203	Residential	B	1	67	64	60	4	
06-204	Residential	B	1	67	65	63	3	
06-205	Residential	B	1	67	64	62	2	
06-206	Residential	B	1	67	67	64	3	
06-207	Residential	B	1	67	68	65	4	
06-208	Residential	B	1	67	71	66	4	
06-215	Residential	B	1	67	62	53	10	Y
06-216	Residential	B	1	67	67	56	11	Y
06-218	Residential	B	1	67	66	56	11	Y
06-219	Residential	B	1	67	70	64	7	Y
06-220	Residential	B	1	67	72	64	7	Y
06-221	Residential	B	1	67	71	62	9	Y
06-222	Residential	B	1	67	68	61	7	Y
06-223	Residential	B	1	67	59	57	2	
06-224	Residential	B	1	67	61	58	4	
06-229	Residential	B	1	67	64	59	5	Y
06-230	Residential	B	1	67	65	60	5	Y
06-301	Residential	B	1	67	71	70	2	
06-302	Residential	B	1	67	71	69	2	
06-303	Residential	B	1	67	68	64	4	

Receptor Number	Land Use	Category	Units	FHWA/MDOT NAC	Build	Noise Level w/Barr	Noise Reduction	Benefit?
06-304	Residential	B	1	67	69	66	3	
06-305	Residential	B	1	67	68	66	2	
06-306	Residential	B	1	67	70	67	3	
06-307	Residential	B	1	67	70	67	3	
06-308	Residential	B	1	67	71	67	4	
06-315	Residential	B	1	67	65	54	11	Y
06-316	Residential	B	1	67	68	57	11	Y
06-318	Residential	B	1	67	68	57	11	Y
06-319	Residential	B	1	67	70	64	6	Y
06-320	Residential	B	1	67	72	65	7	Y
06-321	Residential	B	1	67	72	64	8	Y
06-322	Residential	B	1	67	70	62	8	Y
06-323	Residential	B	1	67	62	59	3	
06-324	Residential	B	1	67	64	59	5	Y
06-329	Residential	B	1	67	68	61	7	Y
06-330	Residential	B	1	67	68	61	7	Y
Wall 7								
07-01	Residential	B	1	67	69	66	3	
07-02	Residential	B	1	67	70	65	5	Y
07-03	Residential	B	1	67	70	64	5	Y
07-04	Residential	B	1	67	70	64	6	Y
07-05	Residential	B	1	67	70	64	6	Y
07-06	Residential	B	1	67	70	64	6	Y
07-07	Residential	B	1	67	70	64	6	Y
07-08	Residential	B	1	67	71	64	6	Y
07-09	Residential	B	1	67	70	64	6	Y
07-10	Residential	B	1	67	70	64	7	Y
07-11	Residential	B	1	67	70	63	7	Y
07-12	Residential	B	1	67	71	64	7	Y
07-13	Residential	B	1	67	71	64	7	Y
07-14	Residential	B	1	67	70	63	7	Y
07-15	Residential	B	1	67	71	64	7	Y
07-16	Residential	B	1	67	71	64	7	Y
07-17	Residential	B	1	67	71	64	7	Y
07-18	Residential	B	1	67	72	65	7	Y
07-19	Residential	B	1	67	70	64	7	Y
07-20	Residential	B	1	67	72	65	6	Y
07-21	Residential	B	1	67	72	66	6	Y
07-22	Residential	B	1	67	72	66	6	Y
07-23	Residential	B	1	67	72	67	6	Y
07-24	Residential	B	1	67	72	67	5	Y
07-25	Residential	B	1	67	72	68	5	Y
07-26	Residential	B	1	67	72	68	4	
07-27	Residential	B	1	67	71	68	3	
07-28	Residential	B	1	67	72	69	3	
07-29	Residential	B	1	67	72	69	3	
07-30	Residential	B	1	67	72	70	2	

Receptor Number	Land Use	Category	Units	FHWA/MDOT NAC	Build	Noise Level w/Barr	Noise Reduction	Benefit?
07-31	Residential	B	1	67	73	71	2	
07-32	Residential	B	1	67	73	71	2	
07-33	Residential	B	1	67	74	73	1	
07-34	Residential	B	1	67	62	61	1	
07-35	Residential	B	1	67	58	57	1	
07-36	Residential	B	1	67	52	49	3	
07-37	Residential	B	1	67	61	54	7	Y
07-38	Residential	B	1	67	58	51	7	Y
07-39	Residential	B	1	67	61	54	7	Y
07-40	Residential	B	1	67	60	55	5	Y
07-41	Residential	B	1	67	57	52	5	Y
07-42	Residential	B	1	67	54	50	4	
07-43	Residential	B	1	67	59	53	6	Y
07-44	Residential	B	1	67	55	49	6	Y
07-45	Residential	B	1	67	69	69	0	
07-46	Residential	B	1	67	68	68	0	
07-47	Residential	B	1	67	54	49	5	Y
07-48	Residential	B	1	67	52	48	4	
07-49	Residential	B	1	67	51	50	2	
07-50	Residential	B	1	67	53	49	4	
07-51	Residential	B	1	67	55	52	4	
07-52	Residential	B	1	67	52	51	1	
07-53	Residential	B	1	67	59	57	2	
Wall 8								
08-01	Residential	B	1	67	69	66	2	
08-02	School	C	1	67	68	62	6	Y
08-03	Residential	B	1	67	70	62	8	Y
08-04	Residential	B	1	67	72	64	8	Y
08-05	Residential	B	1	67	71	63	8	Y
08-06	Residential	B	1	67	71	63	8	Y
08-07	Residential	B	1	67	71	64	8	Y
08-08	Residential	B	1	67	71	63	8	Y
08-09	Residential	B	1	67	71	63	8	Y
08-10	Residential	B	1	67	71	64	7	Y
08-11	Residential	B	1	67	71	65	7	Y
08-12	Residential	B	1	67	71	65	6	Y
08-13	Residential	B	1	67	71	67	4	
08-14	Residential	B	1	67	71	67	4	
08-15	Residential	B	1	67	71	67	3	
08-16	Residential	B	1	67	71	68	3	
08-17	Residential	B	1	67	60	59	1	
08-18	Residential	B	1	67	55	55	0	
08-19	Residential	B	1	67	53	52	1	
08-20	Residential	B	1	67	53	51	2	
08-21	Residential	B	1	67	57	52	5	Y

Receptor Number	Land Use	Category	Units	FHWA/MDOT NAC	Build	Noise Level w/Barr	Noise Reduction	Benefit?
08-22	Residential	B	1	67	52	49	3	
08-23	School	C	1	67	53	49	4	
08-24	School	C	1	67	53	49	4	
08-25	School	C	1	67	54	49	4	
08-26	Church	C	1	67	60	54	6	Y
08-27	Residential	B	1	67	54	49	5	Y
08-28	Residential	B	1	67	60	54	6	Y
08-29	Residential	B	1	67	56	51	5	Y
08-30	Residential	B	1	67	54	49	4	
08-31	Residential	B	1	67	52	49	3	
08-32	Residential	B	1	67	51	48	3	
08-33	Residential	B	1	67	61	54	6	Y
08-34	Residential	B	1	67	59	53	6	Y
08-35	Residential	B	1	67	56	50	6	Y
08-36	Residential	B	1	67	54	49	5	Y
08-37	Residential	B	1	67	53	50	4	
08-38	Residential	B	1	67	61	55	6	Y
08-39	Residential	B	1	67	57	53	5	Y
08-40	Residential	B	1	67	55	51	4	
08-41	Residential	B	1	67	54	51	3	
08-42	Residential	B	1	67	54	51	2	
08-43	Residential	B	1	67	62	54	8	Y
08-44	Residential	B	1	67	57	52	4	
08-45	Residential	B	1	67	55	52	3	
08-46	Residential	B	1	67	62	60	2	
08-47	Residential	B	1	67	60	59	2	
08-48	Residential	B	1	67	60	59	1	
08-49	Residential	B	1	67	59	58	1	
08-50	Residential	B	1	67	58	58	1	
08-51	Residential	B	1	67	54	51	4	
08-52	Residential	B	1	67	52	49	4	
Wall 9								
09-01	Park	C	1	67	66	63	3	
09-02	School	C	1	67	68	64	4	
09-03	School	C	1	67	65	61	4	
09-04	Residential	B	1	67	63	59	4	
09-05	Residential	B	1	67	67	64	4	
09-06	Residential	B	1	67	68	64	4	
09-07	Residential	B	1	67	68	64	4	
09-08	Residential	B	1	67	68	64	4	
09-09	Residential	B	1	67	68	65	3	
09-10	Residential	B	1	67	68	65	3	
09-11	Residential	B	1	67	68	66	3	
09-12	Residential	B	1	67	58	54	4	
09-13	Residential	B	1	67	54	53	1	

Receptor Number	Land Use	Category	Units	FHWA/MDOT NAC	Build	Noise Level w/Barr	Noise Reduction	Benefit?
09-14	Residential	B	1	67	53	52	1	
09-15	Residential	B	1	67	53	52	1	
09-16	Residential	B	1	67	53	52	1	
09-17	Residential	B	1	67	54	52	2	
09-18	Residential	B	1	67	53	51	2	
09-19	Residential	B	1	67	51	50	1	
09-20	Residential	B	1	67	49	49	0	
09-21	Residential	B	1	67	52	50	2	
09-22	Residential	B	1	67	52	52	1	
09-23	Residential	B	1	67	53	53	1	
09-24	Residential	B	1	67	54	52	1	
09-25	Residential	B	1	67	51	52	0	
09-26	Residential	B	1	67	52	55	0	
CNE 10								
10-01	Residential	B	1	67	67	62	6	Y
10-02	Residential	B	1	67	67	62	6	Y
10-03	Residential	B	1	67	67	61	6	Y
10-04	Residential	B	1	67	68	62	6	Y
10-05	Residential	B	1	67	67	62	6	Y
10-06	Residential	B	1	67	66	61	5	Y
10-07	Residential	B	1	67	68	64	3	
10-08	Residential	B	1	67	67	65	3	
10-09	Residential	B	1	67	68	66	2	
10-10	Residential	B	1	67	68	66	2	
10-11	Residential	B	1	67	59	54	6	Y
10-12	Residential	B	1	67	55	50	5	Y
10-13	Residential	B	1	67	54	50	4	
10-14	Residential	B	1	67	61	55	5	Y
10-15	Residential	B	1	67	57	51	6	Y
10-16	Residential	B	1	67	54	50	4	
10-17	Residential	B	1	67	54	50	4	
10-18	Residential	B	1	67	49	49	1	
10-19	Residential	B	1	67	50	47	2	
10-20	Residential	B	1	67	60	59	1	
10-21	Residential	B	1	67	57	57	0	
10-22	Residential	B	1	67	54	53	0	